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SMALL FRUIT PRODUCTION IN MOUNTAIN AREAS WITH THE USE OF BIOCONTROL AGENTS: INVESTIGATING FARMERS' ATTITUDES AND CONSUMERS' CHOICE IN TRENTINO.

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Chapter 1

Introduction

In the last century, research in agriculture has been devoted to study techniques and pest control management that ensure high level of agricultural productivity. Nevertheless, today agriculture can not be seen only as a production process, but has to adapt itself to the changing needs and demands of the markets. It should be able to accommodate the farmer's need to make profit without compromising the natural resource base for future generations.

The evolution of modern farming has caused agricultural systems to become increasingly dependent on factors such as mechanization, chemical fertilizers and pesticides, and genetically modified plants, thereby jeopardizing their sustainability (Barnett et al., 1995; Dubost and Bighelli, 2002). Crop yields and food quality have improved over the last decades but, at the same time, environmental pollution has increased and ecosystem biodiversity has decreased (Meyer-Aurich et al., 1998; Donald et al., 2004). The use of pesticides has increased the risk of acute and chronic health problems for growers, people living in rural areas and consumers of agricultural produce (Steiner et al., 1995). For these reasons, the European Commission has enacted strict regulations concerning pesticide registration (EEC, 1991) and maximum residue levels in food (EC, 2000) and it has encouraged and promoted research (especially within the VI

Framework Programme) for alternative production methods and agricultural management practices that are sustainable or more environmentally sound that the conventional ones.

Moreover, due to recent food scandals (BSE, dioxin contamination of Belgian food) EU citizens increasingly demand good appearance and a wide choice of food products, reflecting high safety, quality and welfare standards (Lohr, 2000; EC, 2010). Sustainable agriculture has been defined as an agriculture that, over the long term, enhances environmental quality and the resource base on which agriculture depends; provides for basic human food and fiber needs; is economically viable; and enhances the quality of life for farmers and society as a whole (ASA, 1989).

Organic, integrated pest management (IPM) and other low environmental production systems (Pesticide Free Production) are commonly associated with sustainable agricultural systems, but none of these are synonymous with sustainable agriculture (Gold, 2007). They are examples of alternatives that have remarkable benefits for consumers, growers and the environment (Pritts, 2000). Organic agriculture is known as a method of production which refrains from the use of chemosynthetic fertilizers, pesticides and pharmaceutical (Ghorbani et al., 2009), placing the highest emphasis on protecting and enhancing the environmental and minimizing pollution (Liebhardt, 2003). But organic agriculture is not the only alternative aiming to achieve sustainable agriculture (Wu and Sardo, 2010). IPM has been defined by German Plan Protection Act in 1987 as a “combination of methods in which primary attention is paid to biological, biotechnical, plant-breeding and cultivation techniques, and in which the use of chemical pesticides is limited to necessary amount” (Freier and Boller, 2009). IPM is now widely

accepted as plant protection strategy for sustainable farming[1] in all of Europe and is considered to be a standard procedure in perennial crops (Freier and Boller, 2009). In Italy, 75-78% of the sales of Apo Conerpo - the biggest Italian producers' consortium producing more than a million tons of fruits and vegetables – and 80% of the production of the biggest fruit producers' organization in Trentino Alto-Adige is produced according to the principles of IPM (Elia et al., 2008). Unfortunately IPM is not regulated at the European level yet and according to the mixture of tools employed, the externalities produced, both in terms of residues and environmental effects, can be quite different.

However, although IPM has been introduced as common practice since several decades, actually, the part related to the use of biological technique has not found an effective implementation in to the IPM program. One promising tool is therefore to use the BCAs extensively, where BCAs will constitute not just one of the possible components of IPM, but the backbone of the plant protection approach. Biocontrol agents are living organisms capable of suppressing and/or controlling the population or impact of pests (Eilenberg et al., 2001). Thanks to their generally minimal effects on soil fertility and local water quality (Hokkanen and Lynch, 2003) and the absence of chemical residues in the final product, they assure remarkable benefits for consumers, growers and the environment. Properly selected BCAs are not hazardous to human health, reducing the risk of acute or chronic poisoning of field workers. Moreover, biological control provides also as a solution to the developed pest resistance to pesticides (DeBach and Rosen, 1991; U.S.Congress, 1995; Waage and Greathead, 1998).

In the research and development of BCAs, researchers have mainly focused on the efficacy of these agents against pests and diseases. A crucial, yet often neglected,

[1] Studies have shown that IPM systems yield greater biodiversity and reduce pesticide use by at least approximately 20% compared to conventional farming (Freier and Boller, 2009).

element in the development of these products is the socioeconomic analysis of the agro-systems in which the BCA will be applied. However, a market-oriented approach is of primary importance in the design of new products (Cooper and Kleinschmidt, 1995).Exploratory market research allows product developers an opportunity to gain insight into the market, understand the expectations and behavior of the intended consumers, and identify problems and needs that should be addressed as their new product is launched. Moreover, this type of research aids in the identification of factors affecting the probability of the success of the new product, relative to that of other alternatives (McQuarrie, 2005).

Simultaneously with the evaluation of the agro-systems (farms) in which there is the highest probability for successful BCA implementation, it is also important to understand whether there would be a market for products obtained with BCAs by evaluating consumer preferences and willingness to pays for those products. Differentiation mechanism and premium price play indeed a key role in order to internalize increased environmental sustainability and to guarantee economic sustainability (Raffaelli et al., 2004). In the literature different degrees of attention have been devoted to the different production methods. While preferences for organic food have been extensively studied, research into consumer response towards IPM or other sustainable production is currently scarce in the literature (Govindasamy and Italia, 1998; Lourenzani et al., 2011; Spinelli et al., 2008).

This thesis, empirically, analyses both farmers' attitudes towards BCAs and consumers' preferences for fruits obtained employing this alternative method with respect to conventional practices. About farmer's attitude, the present work investigates the growers' habits and perception of an IPM that employs BCAs aiming to understand which are the factors that may prevent the adoption of this strategy on large scale and

which may represent the key for its success. About consumers' preferences, this thesis investigates consumers' response to and their willingness to pay for products obtained with BCAs. Moreover, it aims to discover whether the consumers choice is influenced by threshold values (cut-offs) and by context effects.

The thesis focuses on small fruits crops as they grow successfully in mountain areas as Trentino, they are profitable for growers and are attractive from a market perspective given their health benefits such as a high antioxidant content. Italian small fruits (strawberries, blueberries and raspberries) production is about 158783 tons and spans a wide geographical area (6909 ha) (FAOSTAT, 2007), placing at the 5th place as world producer of small fruits. Since small fruits can be also produced on small scales, this sector is well suited to small farms present on mountainous areas (EC, 2006), contributing significantly to the regional economy and maintaining therefore viable rural communities and creating local employment (Bounous et al., 2007). This is especially true for the Trentino province (Agnolin, 2007). The Trentino production of small fruit was roughly 8000 tonnes on 370 hectares in 2009, representing the 5% at national level according to the official report on agriculture provided by Autonomous Province of Trento (PAT, 2009). In the last decade, this sector has been growing considerably (Table 1.1) reaching 25 millions Euro in 2007 (PAT, 2009). Although small fruits markets are of limited size with respect to other fruits as apple, its importance at commercial level is remarkable (Giongo, 2005). According to a recent survey regarding the market penetration of products made-in-Trentino (Osservatorio, 2010), "Sant'Orsola" – the brand used by a Trentino farmer cooperative specialized in the cultivation and marketing of berries - results to be one of most well known brand at national level.

Table 1.1. Production of small fruits (tonnes) and gross production value (GPV) (at current prices)

Year	Strawberries		Blueberries		Raspberries		Small fruits[a]	
	Tonnes	GPV	Tonnes	GPV	Tonnes	GPV	Tonnes	GPV
2000	2936	9389866	187	1033701	575	3401396	5996	15740419
2001	2500	8040583	290	1522500	620	3329400	4045	15020799
2002	3500	11716002	284	1940169	622	3890272	4967	29133925
2003	3727	14348019	387	2155590	620	4650000	5607	24026216
2004	4100	11349811	377	2097232	716	4136168	6142	20556627
2005	4450	10267048	484	2535802	485	2747313	6241	18076580
2006	4200	12858300	437	2395683	740	4936392	6372	23113282
2007	4000	12917708	803	4769820	605	4846050	6480	25858928

[a]Include Strawberries, blueberries, raspberries, currants, blackberries and gooseberries.

Source: PAT, 2009

Currently in Trentino small fruits are mainly produced according to IPM protocols. Integrating current integrated pest management with BCAs might represent therefore one step forward in reaching the objectives stated by the Common Agricultural Policy (CAP) to face the new challenge of agricultural sector (EC, 2010). In fact, beside contributing to farm incomes in mountain areas and decreasing the risk of land abandonment, it guarantees sustainable production practices, fostering green growth through the innovation (adoption of BCAs). Moreover, in mountain areas it may be a valid alternative to organic production. In fact, being mountain farms of limited size, growing organically could be not advantageous, given that the related productivity is lower than conventional and integrated pest control ones (Bruulsema et al., 2003).

This thesis has been developed as part of different projects, initially SAFECROP and lately ENVIROCHANGE, funded by the Autonomous Province of Trento. The first project, SAFECROP, was oriented toward plant protection technologies against pests and diseases using sustainable low environmental impact methods, while the second project, ENVIROCHANGE, focuses on global change and sustainable management of agriculture in highly developed mountain environment, by assessing the short-term impact of climatic change on agriculture at a regional level (Trentino).

1.1 Outline of the thesis

The general aim of this thesis is to investigate farmers and consumers' attitude for small fruits obtained with a production method that employ BCAs with respect to the conventional agricultural practices.

The thesis is composed of two main parts. The first (Chapter 2) regards the analysis of farmers' perception of use of BCAs in an IPM as pest control strategy, while the second (Chapter 3 and 4) regards the analysis of consumers preferences for small fruits obtained with BCAs.

1.1.1 Part One (Chapter 2)

In Chapter 2, I conducted an exploratory market research by using a semi-structured questionnaire, to investigate farmer perceptions and experiences about BCAs in strawberry IPM programmes in three regions: Trentino, Israel and Germany. The choice to focus in particular on strawberry production was driven by several reasons. First, most soft fruit farms are multi-crop and usually grow mainly strawberries and another small fruit crop (blueberries, gooseberries, raspberries, currants) both to reduce the

risk of loss and to extend the harvest period and therefore the work associated with. Second, among soft fruits, strawberries are the most susceptible to pests and diseases (Prodorutti et al., 2007; Cross et al., 2010) and have the highest number of treatments (IASMA notizie, 2006). Given the increasing reduction of registered pesticides[2] and the demands of the legislation (Pan UK, 2008; Phillips, 2009; Lascaux 2010), strategies employing BCAs can have therefore a broader use in this crop, increasing its healthiness.

This part contributes to the current literature by presenting a first comparative study of producers' perceptions and habits using a biocontrol approach in an IPM program for strawberry pest control in diverse regions characterized by different histories, markets and agronomic practices. The survey focused on levels of knowledge of BCAs, factors that can influence growers' confidence in BCAs, the main problems encountered with their use and strategies that can facilitate the implementation of BCA-based IPM programs. Moreover, it aims to provide some insight about the role of different source of information and of government in spreading information about BCAs.

1.1.2 Part two (Chapters 3 and 4)

[2] Pesticide registration is the process through the ingredients of a pesticide were examined. In the European Community, the evaluation, marketing and use of pesticides (herbicides, insecticides, fungicides etc.) in plant protection are regulated under the Regulation EC 1107/2009 concerning the placing of plant protection products on the market This specifies strict criteria for approval of substances, to ensure a high level of protection for human and animal health and the environment. In particular, this Regulation provides that carcinogens, mutagens, endocrine disruptors, substances toxic for reproduction or which are very persistent will not be approved, unless exposure to humans is negligible. It also establishes a mechanism for the substitution of more toxic pesticides by safer (including non-chemical) alternatives. of industry to provide the data showing that a substance can be used safely with respect to human health and the environment.

This part regards the analysis of the acceptability from the demand side of small fruits obtained with alternative production methods. To estimate the consumer's preferences and willingness to pay for small fruits obtained with the use of BCAs, I performed a Choice Experiment on a sample of consumers of Trentino. This stated preference technique involves constructing multiple scenarios, presenting a choice set and asking respondents to choose the preferred option from among different alternatives described by various attributes (Naidoo and Adamowicz, 2005). To conduct a successful CE, the first and highly important step is the correct specification of the choice set, involving also the identification of the attributes.

Chapter 3 focuses on identifying the attributes that have been shown to be relevant and determinant in purchasing and willingness to pay (WTP) for sustainable grown fruits and vegetables. The choice of what attributes should be chosen is not straightforward and often, as Coast and Horrocks (2007: p.25) highlighted, "the rigour with which attribute development and the choice of levels of these attributes are generally conducted is questionable". The chosen attributes should be relevant for respondent, that means that the conclusion about consumer choice would change if its existence is ignored (Lancaster, 1991: p.56). Moreover, the presence of either too many or irrelevant attributes may lead to more complex task for respondent and therefore lead to greater use of heuristics and more inconsistent and random choice (Blamey et al., 2001). Then, in presence of good with attributes of public nature that consumers can barely ascertain (credence attribute) as in our case, this choice is even more crucial. So, it naturally follows that this step requires more thought and research effort than other stages of the choice modelling process (Blamey et al., 2001: p.133). However, from a discussion with experts in stated preference techniques (John Loomis, Tom Brown, Patricia Champ, Dawn Thilmany and

Gorm Kipperberg at the Colorado State University, Agricultural and Resource Economics Department), it emerged that developing a rigorous and common scientific methodology to identify attributes is not feasible due to the various purposes for which the CE is employed. Rather than examine the numerous studies concerning the CE (Kanninen, 2007) and its use on estimate the WTP for pesticide free food, regional food, and for reductions in pesticide risk exposure (Florax et al., 2005, Nijkamp et al, 2006), I conducted a literature review on the perception of agro-food with public attributes.

This study and the consequent creation of a database represent an original contribution by summarizing the existing research. Previous studies focus on understanding the cues between quality and credence aspects and investigating the role of specific labels or certifications (as Marchesini et al. 2007). Moreover, it contributes: 1) to identify and rank the attributes that have been shown to be relevant and determinant in purchasing and willingness to pay (WTP) for IPM and organically grown fruits and vegetables (F&V); 2) to gain some understanding of the differences and similarities in these findings across the USA, Europe and Asia regions; and 3) to investigate whether the selection and the weight of each attribute are uniquely identified or whether they depend on the specific stated preference technique (CV, CE, survey) adopted.

Chapter 4 focuses on eliciting consumer preferences for small fruits obtained by employing biocontrol agents in an IPM program, trough a choice experiment. From a methodological point of view, I focus on one heuristic consumers may follow in their choice: the use of threshold values (cut-offs) (Svenson, 1996, Swait, 2001, Elrod et al., 2004;). Strong evidence exist that consumer use mainly non compensatory strategies to simplify their decision making (Payne et al., 1993; Scheibehenne et al., 2008). For con-

sumer, therefore cut-offs represent a tool to reduce the cost of making a decision by eliminating alternative that do not meet their requirements (Svenson, 1996; Swait, 2001).

Moreover, a rich literature shows that consumers' choice is often influenced by decision context, defined by the set of alternatives under consideration or by decision environment and task complexity. In stated preference research, context effects have been investigated analyzing the influence of different survey design factors, independent of respondent's characteristics. In making choices, individuals may, indeed, focus their attention on certain aspects of the alternatives and in particular on the value that an option has in relation to the other options in the choice set.

This chapter contributes to the literature by investigating the impact of choice context using a non-compensatory approach. I proposed a discrete choice model that extends Swait's (2001) cut-off approach by incorporating cut-off violations as context effects. The novelty is that the consumer's utility associated to an alternative depends not only on the violation of threshold values in that alternative, but also on violations that occur in competing alternatives. To the best of my knowledge, this is the first CE on food to have focused on the analysis of cut-off violations as context effects.

Moreover, the research differs somewhat from past ones since it focused the attention on attributes not directly related to the taste or flavour of a product. Besides estimating consumers' preferences for small fruits obtained with alternative production systems, this study estimates consumer preference for small fruit obtained with farming practices that aim to mitigate climate changes. In the most recent years, indeed, despite the increasing interest in studying the effect of agriculture on climate change (Desjardins et al., 2007) and of those mitigation practices employable in agriculture to reduce gas

emissions (Johnson et al., 2007), consumers' willingness to pay for fruit produced with low carbon emission is still understudied.

Finally, chapter 5 summarizes the results of the previous chapter and identifies possible directions and open questions for future research.

Chapter 2

Farmers' attitudes toward the use of biocontrol agents in IPM strawberry production in three countries*

2.1 Introduction

In biocontrol agent (BCA) research and development programs, researchers have mainly focused on the efficacy of these organisms against pests and diseases. A crucial, but poorly investigated, element in the development of a BCA is the analysis of the socio-economic environment in which the BCA will be applied. A market-oriented approach is of primary importance in the design of new products (Cooper and Kleinschmidt, 1995). Market research allows researchers an opportunity to gain insight into the market, understand the expectations and behavior of the intended consumers (growers), and identify problems and needs that should be addressed as their new product is launched. Moreover, this type of research aids in the identification of factors affecting the success probability of new products, relative to that of other alternatives (McQuarrie, 2005). Since biocontrol strategies for pest management are relatively new, market research can help researchers identify those pest/plant systems in which there is the highest

* This chapter is based on: Moser R., Pertot I., Elad Y., Raffaelli R. (2008) - Farmers' attitudes toward the use of biocontrol agents in IPM strawberry production in three countries. Biological Control,. 47, p. 125-132.

probability for successful BCA implementation and assist in the development of commercial BCAs.

Whereas previous studies have addressed the adoption of integrated pest management (IPM) strategies from regional and policy perspectives (Beckmann and Wesseler, 2003; Lee, 2005), our paper aims to investigate farmers' perceptions and experiences concerning BCAs applied in an IPM program in three regional contexts: Trentino province (Italy), Sharon area (Israel) and North Rhine-Westphalia (Germany). These three regions are characterized by different histories, markets, and agronomic practices. In particular, Trentino growers have a long tradition of using IPM systems and produce mainly for the domestic market. Israel also has a long history of strawberry production that is mainly oriented to the export market, but IPM has been introduced relatively recently. German growers are fairly new to strawberry production, but have a long tradition of IPM in other crops. We investigated the differences in current socio-economic farm conditions and in farmers' attitudes, knowledge, confidence, and problems in adopting BCAs for strawberry IPM production.

2.1.1 Strawberry background

Global strawberry production in 2004 was about 3,683,940 tons and spanned a wide geographical area: 253,950 ha in 70 countries (FAOSTAT, 2005; http://faostat.fao.org/site/340/DesktopDefault.aspx?PageID=340). Among the outdoor horticultural crops, strawberry production provides an insightful case study for at least two reasons: it has the highest market value per hectare – in Italy, for example, the net profit for 2003 ranged from 7,272 to 14,191 €/ha (Emilianet, 2004; http://www.sinab.it/programmi/servizi.php?tp=news&par=2004&id=219) – and it has

been rated as one of the top six most tainted foods, and hence has increased the concern about the presence of chemical residues by consumers (Environmental Working Group, 2006; http://www.foodnews.org/release.php). Several commercial or semi-commercial BCAs are available for use against a long list of pests and pathogens that attack this crop. Numerous BCAs have been described as effective against diseases such as grey mould, *Botrytis cinerea* Pers. ex. Fr. (Boff et al., 2002; Guetsky et al., 2002; Nobre et al., 2005; Shafir et al., 2006), anthracnose, *Colletotrichum acutatum* Simmonds (Freeman et al., 2004), Phytophthora ,*Phytophthora cactorum* (Lebert et Cohn) Schröter (Porras et al., 2007) and powdery mildew, *Podosphaera aphanis* (Wallroth) Braun & Takamiya (Pertot et al., 2007); insects such as thrips (Steiner et al., 2006), aphids (Easterbrook et al., 2006) and root weevil (Mahar et al., 2004); mites (Rhodes et al., 2006); nematodes and mollusk pest (Cross et al., 2001). About two dozens BCA based products are already commercialized.

2.1.2 The regions

The three areas selected differ in climate, environment, the extent of pest and disease problems, farm size and markets, and in the level of organization and coordination among growers. Trentino is a mountainous province with a continental-alpine climate characterized by cold, snowy winters, cool summers, and rainy springs and autumns. In 2004, there were about 1,500 farmers involved in strawberry production, but only 130 produced strawberries exclusively. The individual strawberry producer generally had very small farms (50% of the farms cover less than 0.5 ha, 34% of the farms cover less than 0.5-1.5 ha and 16% of the farms cover more than 3 ha). The total strawberry acreage was about 125 ha, representing 3.3% of the total Italian strawberry acreage. Almost all of

these strawberries (96%) were grown in soilless substrate (tray plants) under high tunnel system between April and October. Most growers were organized in cooperatives and produce mainly during the summer for the national market (90%). Strawberry production was initiated in Trentino in the 1970s and the first IPM programs in agriculture were introduced in the mid-1980s (authors' personal knowledge). The most severe pest and disease problems are caused by powdery mildew (*P. aphanis*), Phytophthora (*Phytophthora fragariae* Hickman*)* and mites (*Tetranychus* spp.).

The Sharon area of Israel is flat and has a Mediterranean climate characterized by long warm, dry summers and short, relatively cool and rainy winters. In 2006, strawberry farms were less numerous (180) and larger than those in Trentino (67% of the farms cover 2-5 ha, 28% cover less than 2 ha and 5% cover 5-25 ha). These farms covered an area of almost 400 ha and represented 71% of Israeli strawberry acreage. Most strawberries were grown in low tunnels and harvested in late winter. Growers were affiliated with marketing companies and most (86%) focused on the export market, especially in the winter. The most important of the pests and diseases in this region were powdery mildew, followed by anthracnose (*Colletotrichum* spp.) and mites.

North Rhine-Westphalia (NRW) is the largest federal state of Germany. It is mainly a lowland plain with an oceanic climate characterized by relatively mild winters and comparatively cool summers; rain falls throughout the year. In 2007, strawberry production involved 180 farms, covered an area of roughly 1,208 ha (representing 10% of the Germany strawberry area) and, differently from Trentino and the Sharon area, most production is in open fields during the spring and summer (only 3% in greenhouses). Growers were mainly oriented toward their domestic market and were not organized into cooperatives, selling their produce directly to consumers or wholesalers. The most im-

portant pests and diseases in this region were grey mould (*B. cinerea*), Phytophthora, and mites.

2.2 Materials and Methods

2.2.1 The survey

Our research was based on a quantitative survey that focused on the use of BCAs in strawberry (*Fragraria ananassa* Duch.) production. The survey investigated knowledge of BCAs, factors that influence growers' confidence in BCAs, the main problems encountered with their use, and strategies that can facilitate the adoption of BCA-based IPM programs.

For this survey, we used a semi-structured questionnaire with closed- and open-ended questions, designed according to the principles outlined by Silverman (2000). The questionnaire consisted of closed – binary or multiple choice – items followed by close- and open-ended follow-up questions to obtain information about attitudes towards and the usage and perception of BCAs, while open-ended questions were used to more broadly explore the problems associated with BCAs (see Appendix 2.A).

A preliminary questionnaire was designed according to the principles of market research (Brace, 2004) and the psychological criteria of experimental design (Trochim, 2000). The topics to be explored were identified by combining information gathered from group discussions with few growers, technicians and researchers and a survey of the existing literature. A pilot test of the survey was performed by asking five researchers and four growers to evaluate the first draft. This allowed us to collect additional information and develop the final form of the questionnaire.

The questionnaires were translated from Italian into German, Hebrew, and English. The survey was conducted in the three regions at different times: in Trentino during late fall 2004, in the Sharon area during spring 2006, and in North Rhine-Westphalia during spring 2007. The survey was administered in person to a total of 86 growers and 20 agricultural technicians and managers working in strawberry production. To reduce interviewer bias, only one trained interviewer administered the questionnaire. In Israel and Germany, the interviewer was accompanied by a local technician who translated the answers for the interviewer. In order to verify the data, the interviewer extensively probed the translated responses; respondents had the opportunity to explain and comment on each question. Detailed notes were taken during and following each interview. Twenty to 30 min were allocated for each interview. Participants were guaranteed anonymity and the data were analyzed in aggregate form, so that neither individual persons nor companies could be identified.

Given the categorical nature of most of our variables and the small size of the samples, the data were analyzed using univariate descriptive statistics and the differences between the regions were tested using standard techniques.

2.2.2 The samples

Small samples of farms were used to represent a significant area of strawberry cultivation in each region. The probability of a farm being sampled was positively correlated with its size. This choice was driven by the fact that the adoption of BCAs in IPM programs may be more feasible for larger farms, given their greater access to the capital necessary for managing the increased costs of sustainable agricultural practices. As a result of the sample selection method, according to which smaller farms were less likely to

be selected, the farm size distribution was skewed toward larger operations (Table 1.1). Moreover, this kind of non-probabilistic sampling did not allow us to calculate sampling errors. However, to increase data reliability and to validate survey results, we involved stakeholders and several experts competent on the investigated topic to discuss our findings. Although this did not allow us to make statistical inferences, however, stakeholder participation showed us that our findings can be considered reliable. Evidence showed that the use of a collaborative approach (stakeholder participation) can help to enhance the likelihood of producing valid evaluation findings (Brandon, 1998). Brandon (1998, p. 326) analyzed fours studies employing stakeholder participation in the field of educational program evaluations and found that: "when stakeholders participated in significant ways during the beginning or ending phases of evaluations, the evaluations examined in these studies also had characteristics of the non-collaborative approach, in that their primary focus was on collecting and reporting valid findings".

In Trentino, 22 strawberry growers were selected (13.6% with less than 0.5 ha of strawberries, 72.8% with 0.5 to 3 ha and 13.6% with more than 3 ha), representing 32% of the Trentino cultivated strawberry area (40 ha) (Table 1.1). The average strawberry cultivation area of the sampled farms was 2.3 ± 1.6 ha (mean ± SD).

In the Sharon area, 44 growers were selected, 30% of which cultivate less than 2 ha of strawberries, 47.3% cultivate between 2 and 5 ha and 22.7% cultivate an area of 5 to 25 ha (Table 1.1), covering 40% of the region strawberry area (80 ha). The average cultivated strawberry area per farm was larger than in Trentino, at about 4 ± 3.4) ha.

In North Rhine-Westphalia (NRW), 20 strawberry growers were selected (35% with farms of between 0.75 and 5 ha of strawberries, 40% with farms between 5 and 15 ha and 25% with farms between 15 and 100 ha (Table 1.1), representing 30% of straw-

berry production area in the NRW region (361.6 ha). Since farms in NRW were highly homogenous, it was possible to keep the representative sample smaller than those of the other two areas. The average strawberry acreage per farm was much larger than in the other surveyed regions: that is about 18.1 ha (where median is about 9 ± 2.6).

Table 1.1. Percentage sample farms according to the size in Italy, Israel and Germany (n = 86)

	Trentino, Italy	Sharon area, Israel	North Rhine–Westphalia, Germany
Farm size (hectares)			
0-0.5	13.6	-	-
0.5-1	18.2	11.4	10.0
1-3	54.5	40.9	10.0
3-5	9.1	25.0	15.0
5-10	4.5	18.2	35.0
10-20	-	4.5	5.0
20-50	-	-	15.0
50-100	-	-	10.0
Mean area of farms (hectares)[a]	2.3 (1.6)[a]	4 (3.42) [a]	18.1 (26.6) [a]
Median area of farms (hectares)	2	3	9
Mean area of population farms (hectares) [c]	0.93	2.2	6.7

[a] standard deviation in parentheses

[c] pooled data

Besides growers, twenty cooperative managers and extension service technicians from the three regions were interviewed to obtain additional information and opinions about the attitudes of cooperatives and extension services toward the use of BCAs: specifically what strategies have been used to promote the use of BCAs and overcome the

barriers to the widespread use of biocontrol methods in IPM programs. We considered the responses to these questions during our analysis of the questionnaire data.

2.3 Results and Discussion

2.3.1 Socio-economic characteristics

In Italy, the average age of the interviewees was 41, nearly all of them (86%) were male and more than half (68%) had a secondary school diploma. Most of them owned their land (86%), worked full-time on their farms (72%) together with other family members (90%), and have worked on their farms for an average of 17 years.

In Israel, the average age of the interviewees was 46, all of them were male, and most of them (93%) had a secondary school diploma. Most of them (88%) owned their land, worked on their farms full-time (97%), usually with the help of a son or other family member (82%), and had worked on their farms for an average of 19 years.

Most of the respondents (95%) in Germany were male, with an average age of 42 years. All of these growers possessed secondary school diplomas. Most of these growers owned their land (70%) and have been working full-time on their farms for an average of 16 years, usually with the assistance of another family member (65%) (Table 1.2).

While the prevalence of males was high across all three selected regions and the mean age of the farmers is not statistically different, several other differences are apparent. Education levels were higher in Germany: all of the surveyed farmers had at least a secondary school diploma and a quarter of them a university degree as well. Farms were significantly bigger (Chi-square = 23.43, df = 4, $P < 0.001$) in Germany than in Italy and Israel. However, even when farming was the main activity, it was the major source of income for only 20% of the German sample, while in Italy and Israel it represented the ma-

jor source of income for 73% and 82% of the respondents, respectively. The Italian and German growers produced primarily for their domestic markets, while Israeli growers were focused on the export market. This difference can be explained by the production periods in the three regions: the Israeli strawberry harvest takes place during the winter when prices are high in European markets. In northern Italy and Germany, strawberries are harvested during late spring and summer. The Israeli focus on the export market, which requires highly professional organizational and marketing skills, explains the high rates of full-time on-farm employment and the low level of family participation in the production; strawberries were these growers' primary source of income. The traditional European farm structure can also partially explain the differences between the Israeli and the Italian samples. The small average size of the farms in the Italian Alps is the result of property fragmentation caused by land reforms, population growth, and other factors such as the difficulty of mechanization in this region (Thomas, 2006).

Table 1.2. Summary of selected samples characteristics in Italy, Israel and Germany (n = 86)

Characteristics	Trentino, Italy	Sharon area, Israel	North Rhine–Westphalia, Germany
Mean age of farmers (years)	41 (12.4) [a]	46 (12.5) [a]	42 (7.8) [a]
Male [b]	86.4	97.7	95.0
High school diploma [b]	68.2	93.2	100
College/university degree [b]	13.6	11.4	25.0
Property ownership [b]	86.4	88.6	70.0
Focused on the export market [b]	10.0	86.4	3.8
Average years worked on the farm	17.0 (9.0) [a]	19.0 (12.2) [a]	16.0 (8.8) [a]
Employed on the farm full-time [b]	72.7	97.7	100
Farm is the main source of income [b]	72.7	81.8	20.0
Family member participation in farm operations [b]	90.0	52.3	65.0

[a] standard deviation in parentheses
[b] percentage of sample possessing the specific characteristic

2.3.2 The level of knowledge about BCAs

The major features identified by growers in all three regions were that BCAs have "less environmental impact", entail "higher costs of monitoring the crop", and are "more sensitive to climatic factors", and that they "have a slower and weaker effect" than chemical pesticides (Table 1.3). The data collected from a close-ended question showed that Italian and Israeli growers also thought that BCAs "are safer for the person who is applying the pesticide treatments" and "give healthier product", but also complain that commercial BCAs "carry a higher cost" than chemical pesticides in either direct costs or indirectly for the labor of monitoring and releasing.

Table 1.3. Characteristics of biocontrol agents (BCAs), as identified by growers (n = 86) in Italy, Israel and Germany (more than one answer was possible).

Features of BCAs	Proportion of interviewees who marked the specific feature on the questionnaire (%)		
	Trentino, Italy	Sharon area, Israel	North Rhine–Westphalia, Germany
Positive characteristics			
No chemical residues on fruit	18.2	95.5	60.0
Less environmental impact [a]	90.9	97.7	75.0
Increased worker safety [a]	72.7	100.0	20.0
Healthier product for consumers [a]	81.8	100.0	25.0
Negative characteristics			
Higher cost of the BCAs[a]	54.5	54.5	25.0
Higher cost of crop monitoring [a]	50	65.9	35.0
Lower efficacy, if used alone [a]	54.5	65.9	20.0
More sensitive to weather conditions [a]	63.6	86.4	55.0
Increased risk of losses due to pest damages [a]	54.5	22.7	30.0
Slower and weaker effects [a]	63.6	63.6	45.0
Shorter shelf-life (of the harvested produce) [a]	18.2	75.0	30.0
Number of total respondents	22	44	20

[a] as compared to chemical pesticides

There are some interesting differences among the three groups. The most important difference concerns the features “the chemical residues are absent (non-detectable)” and BCAs “give healthier product”. Italian and German growers perceived these two characteristics in very different ways. Italian growers perceived the health value and safety of BCAs, but they did not correlate them with the absence of chemical residues, while German growers remarked about the absence of chemical residues on the final product, but not about the healthier quality of the product. German growers did not associate the decision to use BCAs or chemical pesticides with any effects on their own health, probably because, in Germany, pesticides are already applied following extensive safety instruction and, therefore, are not considered to be harmful to human health. This lack of linkage can partially explain the reason why both Italian and German consumers – in this situation, growers were acting as consumers – were not willing to pay a higher price for strawberries grown with BCAs.

In contrast to the Italian and German growers, Israeli growers perceived a linkage between the absence of chemical residues and a healthier product. This can be explained by the fact that Israeli production is primarily exported to the UK. Actually, detecting chemical residues above the maximum level (set for safety and health protection reasons) by the supplier or retailer company (i.e., Agrexco in Israel or Mark & Spencer in UK) can lead to product rejection, endangering the farm’s profit. Moreover, being most retailers and suppliers members of EurepGAP (now GlobalGAP; Germany), a private sector body that sets voluntary standards for the certification of agricultural products, they require all producers to apply them.

Unlike Israeli and German growers, Italian growers were more risk-adverse, associating a greater risk of losses with the use of BCAs, even when these risks were not

documented. Israeli growers were the only ones to express concerns about the reduced shelf-life of BCA-treated strawberries. This may be related to the use of BCAs against *B. cinerea* (grey mould). A failure to control this pathogen, results in fruits rot, which shortens strawberry shelf-life. In general, the German sample exhibited the lowest rates of perception of both the positive and negative characteristics of BCAs (Table 1.3).

The primary sources of information for farmers regarding BCAs were other growers, extension agents, and agricultural journals (local or national), followed by the popular media (TV, radio, internet) as second source. In Trentino and North Rhine-Westphalia, most known BCAs were predators, pheromones, and nematodes, while in Sharon area they were predators and bioinsecticides.

2.3.3 Confidence in BCAs

To investigate farmers' confidence in BCAs, a binary close-ended question and a related follow-up question were employed, since we were interested in understanding if growers trust BCAs or not – and the reason why – and not their degree of confidence in BCAs. If a grower has confidence in BCAs, then he/she would be more willing to experiment and to adopt them in an IPM program or alone. Conversely, if a farmer does not trust these agents at all, they would be less prone to try and this would imply more effort and the use of strategies that aim to instill trust in growers.

Israeli growers placed greater trust in BCAs (91%; Chi-square = 4.74, df = 2, $P < 0.1$) than either Italians (77%) or Germans (70%). 30% of the German respondents, 23% of Italian growers, and 9% of the Israeli growers (9%) expressed a lack of trust in BCAs. However, 17% of the skeptical Germans, 30% of the Italians, and all of the Israeli growers used them even if they stated that they did not trust them.

In both Italy and Israel, the most frequently mentioned factors influencing growers' confidence in BCAs were personal experience and suggestions made by cooperatives or growers' associations (Fig. 1.1). In Germany, however, positive publicity – both word of mouth and advertising – was the most influential factor affecting growers' stated confidence in BCAs.

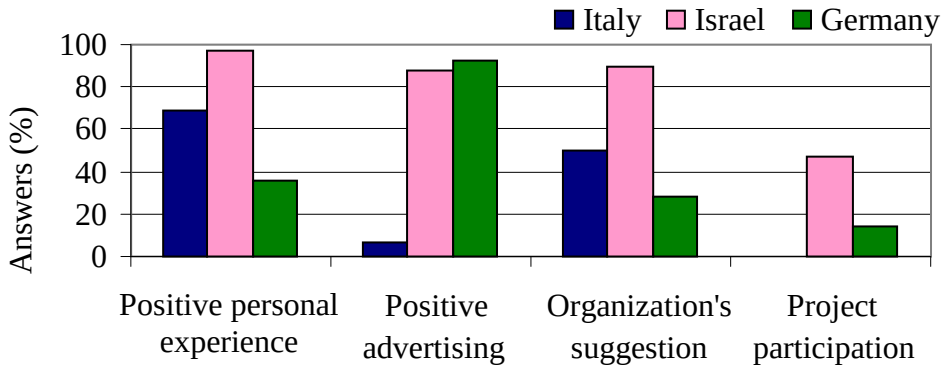

Figure 1.1. Factors influencing growers' confidence in BCAs in Italy, Israel and Germany (as percentage of the sample that answered positively).

Compared to that of Italian and German growers, Israeli's high confidence in BCAs was affected by the role that project participation plays in their system. In order to expand the use of BCAs, the local extension service and the growers' association in Israel have made efforts to involve growers in demonstration projects and to promote the sharing of positive experiences with BCAs.

With regards to the Germans' lack of confidence, two main factors were identified: lack of experience and fear of losses due to the low efficacy of BCAs as compared to that of chemicals (40% of farmers cited them). Secondary causes were the belief that chemical pesticides are better then BCAs (25% of farmers), the limited promotion of

these methods by research centers, companies and media (15%), and any personal negative experiences of growers or their colleagues (10 and 5%, respectively).

To obtain more insight on factors that influence growers' confidence in BCAs beyond the above descriptive results, we ran an exploratory binary logit model using growers' personal characteristics (age, education, years of farming, use of BCAs in other crops) and farm characteristics, and sources and type of information regarding BCAs (Table 1.4). The model correctly classified 85% of the observations, and the most significant predictors were media as a source of information about BCAs, the positive characteristics of BCAs, and years of farming experience.

Among the different sources of information (journal, media, and word of mouth), the only estimated coefficient found to be significant was that related to "media" (Coefficient = 1.62; $P = 0.020$), which indicates that information coming from TV, radio, internet, and newspapers can increase the probability of trust in BCAs.

As regards the effect of the characteristics of BCAs as perceived by growers, we found that "positive characteristics" significantly and positively ($P = 0.013$) affected BCA adoption, while "negative characteristics", although negative, had a surprisingly non-significant effect ($P = 0.247$).

Strawberry farming experience was also found to decrease the probability of trust in BCAs, even though the magnitude of this effect was quite modest ($P = 0.037$). This result indicates that more experienced strawberry growers tend to be less confident about using BCAs incorporated into an IPM program. A possible explanation may be that using a consolidated control program for several years leads growers to be less likely to trust a strategy (BCAs) that is still somewhat experimental. Other farmer characteristics such as

age, educational level, and the variable “previous use of BCAs in other crops” were also included in the model, but they were found to be insignificant (Table 1.4).

Table 1.4. Determinants of growers’ confidence in biocontrol agents (BCAs) (logit regression on pooled data, n = 86).

Determinants	Coefficient (standard error)
Age	0.045 (0.040)
College (Education)	-0.909 (0.864)
Years in farming	-0.087 (0.043)*
Use of BCAs in other crops	0.414 (0.792)
Farm size (ha)	-0.019 (0.174)
Positive characteristics	0.776 (0.351) *
Negative characteristics	-0.247 (0.230)
Journals as a source of information	-1.018 (1.327)
Media as a source of information	1.523 (0.703)*
Word of mouth as a source of information	-0.691 (1.437)
Constant	-0.750 (2.000)
Observation (Groups)	86 (3)
Prob. > chi^2	<0.05
Pseudo R^2	0.230
Correctly classified (%)	84.88

*significant at 5%

2.3.4 The use of BCAs in current IPM programs

Regarding experimentation and adoption of BCAs in strawberry IPM programs, farmers used BCAs to control similar problems with different relative impact in the three regions. In Trentino, 77% of growers had used a BCA at least once: specifically 63% employed nematode to control weevil (*Otiorhynchus* spp.) and 25% predators such as *Phytoseiulus persimilis* Athias-Henriot and *Orius* against spider mites and thrips, respec-

tively. In North Rhine-Westphalia, 60% of growers used a BCA at least once to control mainly mites and thrips (71%) and weevil (*Otiorhynchus* spp.; 28%). Nevertheless, in current management practice, BCAs are applied only in tunnels and greenhouses: *Aphidius colemani* Viereck against aphids and *P. persimilis* against spider mites. In Sharon area, all of the surveyed farmers regularly used *P. persimili*s for the control of mites (100%), *Aphidius colemani for* aphids (86%), and *Orius laevigatus* (Fieber) for thrips (84%). In total, 73 of the 86 growers surveyed had experimented with the use of BCAs as part of an IPM program. In general, our study found that the levels of satisfaction of respondents who had experience using BCAs were significantly different in the three regions (Chi-square = 10.79, df = 4, $P < 0.05$). In particular, there was a significant difference between grower satisfaction levels in Italy and Israel (Chi-square = 9.84, df = 2, $P < 0.01$), while the differences between levels of satisfaction in Italy and Germany (Chi-square = 2.07, df = 2, $P > 0.1$) and Israel and Germany were not significant (Chi-square = 3.86, df = 2, $P > 0.1$; Table 1.5).

Table 1.5. Level of satisfaction by growers using biocontrol agents (n = 73) in Italy, Israel and Germany (as percentages of the sample).

Level of satisfaction	Trentino, Italy	Sharon area, Israel	North Rhine–Westphalia, Germany
Satisfied	53.0	88.6	75.0
Indifferent	29.0	9.1	8.3
Unsatisfied	18.0	2.3	16.7
Number of total respondents	17	44	12

2.3.5 The main problems encountered in the use of BCAs

Data were collected from an open-ended question that asked growers who had used BCAs at least once to list the major problems encountered in the use of BCAs. Our findings showed that practical constraints were the inability of BCAs to achieve total control of pest and diseases, the high sensitivity of BCAs to weather conditions, the need to apply BCAs at a specific point in time (they can be ineffective if applied too early or too late), the time need to monitor the pest and the crop, and the higher cost of BCAs, compared to that of chemicals (Table 1.6).

Even if these problems were common to all three regions, these issues had differential impacts in the three regions. The main problem reported by the Italian growers was the amount of time required for monitoring (35%), while Israeli growers considered the lack of full pest control (45%) most troublesome and worried about the influence of weather on the efficacy of BCAs (34%). Most Trentino growers perceived the time spent in the field monitoring the crop to be wasted. This can be partially explained by the fact that, in Trentino, growers generally work only part-time on their farms, so the time spent on monitoring activities is perceived more acutely. This result confirms Beckmann and Wesseler's (2003) findings that the adoption of sustainable practices with high labor intensity will be less in regions with high opportunity costs and a more differentiated organization of agricultural labor. The worries of Israeli growers' can be explained by the fact that strawberries are their main (often only) source of income and that the dry and warm climate can be prohibitive for the establishment of some BCAs. German growers assigned a equal level of importance to the following issues: the effect of weather conditions on the efficacy of BCAs (33%), incomplete pest control (33%), the high price of BCAs (25%), and the absence of a product warranty (25%). In each sample of farmers

who were satisfied users of BCAs, 17-30% did not respond when asked about their specific concerns.

Table 1.6. Main problems listed by growers using BCAs (n = 73) in Italy, Israel and Germany (as percentages of the sample) as answers to an open-ended question.

Problems associated with BCAs	Proportion of interviewees who listed the specific problem on the questionnaire (%)		
	Trentino, Italy	Sharon area, Israel	North Rhine–Westphalia, Germany
Sensitivity to weather conditions	11.7	34.1	33.3
Need for precise timing of applications	17.6	15.9	16.7
Less than total control	23.5	45.5	33.3
Time spent monitoring	35.3	6.8	16.7
High price of BCAs	11.7	2.3	25.0
Drift effect	5.8	6.8	0.0
Lack of warranties	0.0	0.0	25.0
No answer	17.6	29.6	16.7
Number of total respondents	17	44	12

2.3.6 Strategies to increase the adoption of BCAs in IPM programs

The following discussion has been based on information gathered in interviews with managers and technicians. The strategies implemented to expand the use of BCAs varied in the three regions. Differences were related to specific socio-economic conditions, farm management and organizational structures, and the presence or absence of a cooperative. In Italy and Israel, most growers were associated with the strawberry marketing board of their local growers' associations, while in Germany, growers sold most

of their production directly to consumers from their own stand, but the larger ones also sold to wholesalers.

In Israel, the introduction of IPM has been relatively recent, as compared to Trentino (Moser et al., 2007). The Israeli's strategies have yielded surprising results: the use of BCAs (measured in number of hectares of strawberries treated with BCAs) increased in Israel from 2 (less than 1%) to 210 ha (67%) between 1997 and 2003. Moreover, the successful application of IPM reduced insecticide applications by 30% and increased fruit consumption and farmers' income (Gnayem et al.; unpublished information). The Israeli growers' association used several strategies to increase the use of BCAs, and farmers considered these to be of different levels of importance. In particular, the growers' association invested in advertising that differentiated the BCA-treated product in the marketplace, in an effort to increase consumers' awareness of the positive characteristics of IPM products (perceived by 71% of the growers as useful). The Israeli government partially subsidized the packaging of BCAs in order to cover the additional costs and risks that growers incurred in changing pest control methods from pesticides to BCAs (perceived by 57% as useful). Moreover, the Israeli government offered free technical support at the beginning of the program, but increasingly charged fees for this service over time (perceived by 42% as useful). As a consequence of the combination of these three strategies, the price of IPM strawberries has been increased by 43%, thereby guaranteeing the growers a fair profit (Fig. 1.2).

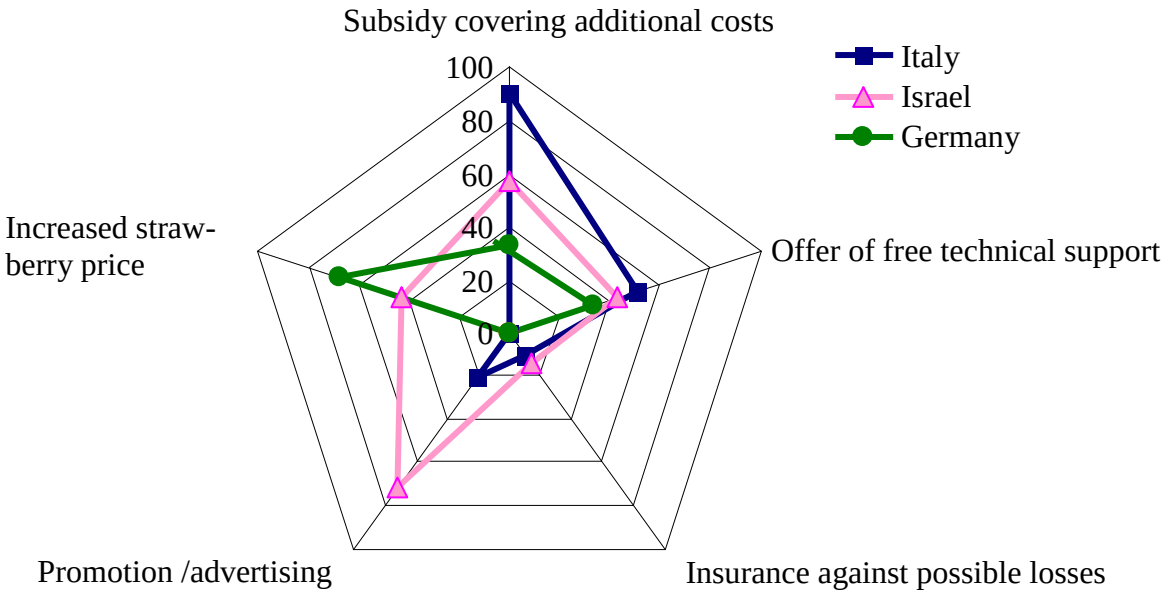

Figure 1.2. Perceived relevance of strategies that might increase growers' use of BCAs in Italy, Israel and Germany (as percentages of the selected managers).

In Trentino, since most strawberry production is produced according to an IPM program and beneficial insects, mites, and microbes have already been used against insects, the introduction of additional BCAs would not be perceived by consumers as providing any difference in product quality and, therefore, would not be rewarded financially in the marketplace. Thus, the Trentino managers and technicians (Fig. 1.2) believed that the most important strategy for promoting the expanded application of BCAs would be subsidies (90%) to cover the additional costs associated with the use of BCAs, followed by offers of free technical support (50%).

In Germany, the absence of a growers' association may partially explain the low level of BCA use. According to the experts and advisors we interviewed, the best method for encouraging the use of BCAs would be to increase the price of the strawberries pro-

duced by using BCAs instead of chemicals through a product differentiation (67%), followed by subsidies for farmers (33%), and free technical support (33%).

2.4 Conclusions and future research

This is the first comparative study of producers' perceptions and habits using a biocontrol approach in an IPM program for strawberry pest control in diverse agricultural systems. Many factors influence the adoption of BCAs as part of an IPM program and the relevance of these individual factors depends upon farmers' attitudes toward biocontrol and the specific socio-economic conditions of the context in which the BCAs are to be applied. Thus, the conclusions presented here do not necessarily apply generally, since they are specific to the three examined regions.

Personal hands-on experience and suggestions made by cooperatives or growers' associations were the most mentioned factors influencing the confidence of growers in BCAs in Trentino and the Sharon area. In contrast, positive publicity – such as word of mouth and advertising – was most influential in North Rhine-Westphalia. Lack of confidence by farmers in BCAs, when observed, was often generated by inexperience, fear of losses due to the low efficacy of BCAs, the belief that chemical pesticides are better than BCAs, and by the limited promotion of these methods by local research centers and biocontrol companies. Regarding the limited promotion, this can be explained by the structure of the BCA industry and the lack of support by the leading agrochemicals companies. According to Blum (2002; http://www.ibma.ch) most BCA producers are small enterprises and many have a turnover of less than $1 million, which is not high enough to justify any market development effort. Moreover, since the commercialization of BCAs has prohibitive registration fees, a large market is needed to make this registration profit-

able, even for chemical companies (Guillon, 2004; http://www.ibma.ch). Since BCAs remains a specialized niche market (Spadaro and Gullino, 2005), it is impossible to reach the same financial profit levels as chemicals, leading companies to abandon BCA production. This is true also for chemical enterprises. As Blum (2002; http://www.ibma.ch) reports, the chemical enterprises do not wish to see their sales figures decrease, and therefore, they develop strong arguments and spend considerable money on advertising in order to convince farmers that chemicals and easy to use, effective, cheap, and are constantly being improved in order to guarantee safety.

Another factor that may prevent the spreading of BCAs is the fact that producing food using IPM is becoming a general standard rather than a specific market and that IPM food is generally sold at the same price as conventional (Levidow and Bijman, 2002). Then, the lack of any special recognition of IPM in food market may make difficult the implementation of differentiation strategies that aims to convince consumers that these practices confer a value added and therefore to convince them to pay more for IPM (and IPM +BCAs) derived products.

With regards to the influence of other variables (type of information, source of information, and grower and farm characteristics), regression analysis demonstrates that only three factors significantly affected growers' confidence in BCAs: media coverage, the positive attributes of BCAs, and years of strawberry farming experience. The study concludes that only knowledge of the positive effects of BCAs will increase the probability of a grower having confidence in BCAs, regardless of the number of negative features known to growers. This might be due to the perception that the social and environmental benefits deriving from the use of more sustainable practices outweigh the higher costs of

BCAs and the risks of increased yield losses. However, these interesting results need further investigation.

Differences in growers' attitudes are related to the agricultural systems in which they operate. Consumer-oriented production, the presence of growers' associations and expert advisors, a well-planned pest control program, and an organized network that publicizes results of experimental trials are factors that may increase growers' knowledge of BCAs and thereby facilitate the inclusion of BCAs in IPM programs.

Government also plays a key role in fostering the use of BCAs. Providing indirect assistance – spreading information, educational material, practical advice, and regular contacts between all parties – through extension services, as done in Israel, rather than giving direct assistance (subsidies) seems to obtain better results in terms of the diffusion of sustainable practices, confirming the results of Allen et al. (2002; http://www.maf.govt.nz/mafnet/rural-nz/people-and-their-issues/education/sustainable-development-extension/index.htm).

However, even if the level of satisfaction reported by respondents with experience using BCAs was generally good, to fully integrate BCAs into IPM programs a lot of work still needs to be done, including increasing BCAs' efficacy and spreading information among growers and consumers. In fact, the widespread adoption of BCA use has been delayed and, in some cases such as in Germany, prevented by practical constraints such as the inability to achieve total pest and disease control, the need to apply BCAs on a specific schedule, the sensitivity of BCAs to weather conditions, the time required for pest and crop monitoring, and the high cost of BCAs relative to chemicals. Furthermore, several areas of potential interest for future research have been identified. This study has demonstrated the usefulness of comparative market research in

three regions. Comparing varying agricultural systems and organizations allows researchers to develop insights into how national and local characteristics influence growers' decisions about adopting BCAs in strawberry production and to understand what factors can be altered to increase the successful implementation of BCAs. Moreover, it improves the connection among different research centers and promotes the spreading of the knowledge in the biocontrol field worldwide. However, further investigation should focus on the role of government and of different knowledge networks in shaping strawberry growers' perceptions and in persuading them to act in environmentally sustainable ways. As our results have shown, confirming also Allen et al.'s (2002; http://www.maf.govt.nz/mafnet/rural-nz/people-and-their-issues/education/sustainable-development-extension/index.htm) findings, that information is key to learning and subsequent behavior change, but learning will only happen if it is supported by social processes such as shared understanding and a supportive environment. Finally, further research should be conducted to gain a better understanding of how farmers of other valuable crops react to sustainable strategies, and therefore allowing national and local governments to design more efficient policies.

APPENDIX 2.A

The survey questions, question types and to whom they were administered. The questions were sorted into six different categories based on their respective topic areas: A- philosophical approach, B- knowledge, C- confidence, D- use, E- problems encountered, and F-promotion and technical support.

	Question	Question type	Interviewees	
			Growers	Managers and technicians
A	Which approach to plant protection does your organization promote?	C, M		X
	How does your organization behave/act toward the BCAs?	C, M		X
	If your organization has not yet adopted the use of BCAs, do you know why?	C, M		X
B	What are, in your opinion, the main features of a BCA that distinguish it from conventional (chemical) tools for plant protection?	C, M	X	X
	What are your sources of information on the topic of BCAs?	C. M	X	X
	Which biocontrol agents are you familiar with?	C, M	X	X
C	Do you trust the efficacy of BCAs when used as part of an integrated pest management system?	C, B	X	X

	If YES, why?	C, M	X	X
	If NO, why?	C, M	X	X
D	Do you currently use BCAs on your farm/cooperative?	C, B	X	X
	Against which diseases or insects are you using BCAs?	C, M	X	X
	Are you satisfied by the performance of these BCAs?	C, M	X	X
	Aside from strawberry, do you use BCAs in any other crops?	C, M	X	X
E	What are the main problems you have encountered in your use of BCAs?	O	X	
	In your efforts to promote the use of BCAs, what are the main problems that you have encountered with the growers and the market?	C, M		X
F	What could convince you to use BCAs?	O	X	
	Which strategies do you use (or have you considered using) to encourage growers to apply BCAs?	C, M		X
	Do you use specific marketing strategies to promote strawberries that were grown using BCAs?	O		X

[a] C = closed-ended, M =multiple choices question, B = binary choice question and O = open-ended.

[b]Managers of cooperatives or farms and extension service agents.

Chapter 3

Consumer Preferences for fruit and vegetables with Credence-Based Attributes: A Review*

5.1 Introduction

Over the past two decades, consumer demand for niche products (including organic and locally grown foods) has grown substantially. Various sources suggest that both of these niche food sectors have seen double-digit annual growth (even though local foods were vaguely defined until the United State Department of Agriculture's (USDA) 2010 definition in various grant and agency programs). While some studies suggest that the motivation to purchase organic and local products derives from environmental concerns, other production and quality concerns (nutrition, support for family or small farms, and treatment of animals) are increasingly reported as issues guiding consumer choices (Thilmany et al., 2008). In response, private industries have invested more in branding programs, while various international NGOs and national governments develop and oversee public certification programs meant to address asymmetric information in consumer product markets.

Consumers' perception of quality is influenced by the product's intrinsic attributes as well as by extrinsic indicators and cues provided by the seller of the product

* This chapter has been submitted as paper to IFAMR (International Food and Agribusiness Management Review).

(Caswell et al., 2002). Food as a good can be divided into search, experience and credence goods according to the level of quality that can be discovered by the consumer at different stages (Nelson. 1970; Darby and Karni, 1973). A good is identified as a search good when consumer can evaluate relevant attribute information before the purchase (e.g., price, dimension, size, color), while it is defined as experience good when relevant attribute information can be determined only after consumption (e.g. taste, convenience) (Nelson, 1970, 1974). Credence products are those whose relevant attribute information is difficult to ascertain directly by consumers at any stage of purchase, even after consumption of the food (Darby and Karni, 1973; Torjusen et al., 2001; Grunert et al., 2004). For this reason, credence goods require a judgment or a certification by an authority figure such as a governmental agency, or organization that consumers can trust to lend information on credence attributes (Caswell and Mojduszka, 1996; Becker, 1999). Many agro-food goods fall into this category (Caswell and Mojduska, 1996).

While experience and search good involves usually private good characteristics, credence good provides private benefits to those who consume the good, while its production has "an affiliated public dimensions" (Lusk et al., 2007). The credence good category incorporates, indeed, a wide range of fairly intangible and often interrelated characteristics such as outcomes related to health, environmental conservation, origin, creation of employment, supporting small-scale agriculture and local rural communities, farmers living and producing in marginal and/or disadvantaged conditions and workers' rights. All these attributes fully or partially fall under the realm of public goods (non-excludable, non-rivalrous) (Becker, 1999; Midmore et al., 2005; Darby et al., 2006). An example is food produced according to organic or low impact environmental production systems (such as Integrated Pest Management (IPM)) because they not only are per-

ceived by some as safer for consumption, but also reduce the impact on environment, may protect biodiversity and/or reduce greenhouse gas emissions.

Credence attributes play an increasingly important role in consumer preference formation (Zanoli et al., 2003; Heuvel et al., 2007). Subsequently, the 'bundle of attributes' which constitute a good is evolving in the food system (Arunachalam et al., 2009) as evidenced by the emerging set of new certifications trying to establish themselves as market standards (Food Alliance, Ocean Trust Fish, Fair Trade). Thus, many agribusiness stakeholders could benefit from understanding patterns, consistencies and conflicting research on consumer values for these credence attributes (Travisi and Nijkamp, 2008).

In recent decades, efforts to understand consumer attitudes, or overall buying behavior and the relative importance of various determinants in purchasing food have been widely explored (Kiesel and Villas Boas, 2007), primarily with stated preference techniques such as Contingent Valuation (CV) and Choice Experiments (CE). Stated preference methods are grounded on the consumer utility theory and by employing econometric models they allow to measure the amount people would be willing to pay (WTP amount) for a good or for a specific attribute. But, there may be reasons to compare and contrast approaches that use the two. Both CV and CE methods ask people to express their preferences by choosing between a base case and another alternative in a hypothetical situation (Mitchell and Carson, 1989; Naidoo and Adamowicz, 2005). CV is more suitable to evaluate a good in its wholeness, while CE focuses on the 'bundle of attributes' which constitute a good, according to Lancaster's theory (1991). CE involves constructing multiple scenarios, presenting a choice set and asking respondents to choose the preferred option among different alternatives described by various attributes and prices (Naidoo and Adamowicz, 2005) mimicking a typical consumer shopping experience

(Lusk and Hudson, 2004). In short, it allows researchers to specifically investigate trade-offs between several competing product attributes and to determine the relative importance of various attributes in consumers' choice process (Hanemann and Kanninen, 1998).

More recently, the experimental approach has also been used by employing auction and lab experiments (Lusk and Shogren, 2007; Combris et al., 2009). Finally, general information on consumer preferences and purchasing behavior can be collected through quantitative and qualitative (focus group or in depth interviews) surveys employing rating or ranking questions[3] and Likert scales.

Regardless of the approach, to conduct an effective study the correct identification and definition of the relevant attributes is key (Jones et al., 1986). However, in the majority of empirical studies, the methods employed for performing this task have tended to be arbitrary rather than systematic, by lacking of scientific rigour (Cullinane and Toy, 2000; Coast and Horrocks, 2007). The chosen attributes should be relevant for respondents, since the conclusions drawn about consumer choice would change if we ignore the existence of important factors (Lancaster 1991, 56). Moreover, the presence of either too many or irrelevant attributes may lead to an overly complex decision for respondents, and therefore, may result in more inconsistent and random choices (Bennett and Blamey, 2001).

With this study, we would like to contribute to the field by summarizing the existing research. Previous studies focus on understanding the cues between quality and credence aspects and investigating the role of specific labels or certifications (as Marchesini

[3] Rating questions ask respondent to compare different items using a common scale, while ranking questions asked respondent to compare different items directly to one another ordering them in order of preference.

et al., 2007). The choice to focus only on fruits and vegetables (F&V) is driven by the fact that, as Gil et al. (2000) suggested, environmental attributes are more important in fresh and perishable products, (or at least it is easier to directly identify them in such products), and also, consumers are willing to pay a higher premium for organic fruits and vegetables. The contribution of this study is: 1) to identify and rank the attributes that have been shown to be relevant and determinant in purchasing and willingness to pay (WTP) for IPM and organically grown F&V; 2) to gain some understanding of the differences and similarities in these findings across the USA, Europe and Asia regions; and 3) to inform future consumer research in this market sector.

The paper is structured as follows: section 2 describes the data and analytical methodologies used; section 3 indicates important attributes of consumers buying behaviour of F&V as inferred from their significance; section 4 compares preferences across countries, section 5 is the discussion on relevance of credence goods in WTP and WTBuy decision processes, drawing some implications for sustainable food industry managers and noting limitations and methodological issues that could be addressed with further exploration, with particular attention devoted to CE, and section 6 concludes.

5.2 Data and methodology

To explore consumer preferences for F&V, we focus on studies that try to understand the consumer-based determinants in purchasing sustainably produced fruit and vegetables including those that focus on methodological issues and that report these details within their empirical results.

The literature review conducted for this study relies on a variety of source literature. However, an attempt has been made, however, to limit the analysis to web-based scientific community databases as Scopus, Web of Science, Science direct, Google

Scholar, entering and combining the following keywords “consumer preferences” “perception” “sustainable” “organic” “IPM” “low environmental impact” “fruit” and “vegetable” “credence attributes”. Different sources considered in this review range from scientific to popular studies[4] written between 1998 and 2007, but more recent studies were used to motivate and draw conclusions on how the field is evolving. Since the aim of the review was to identify and rank attributes which affect buying decision and WTP on sustainable F&V, relevant studies include those reporting any evaluation, ranking, rating or estimates of attribute coefficients employing econometric or statistical models. This includes 13 studies based on CV, 9 on CE, 2 on experimental auctions and 16 based on quantitative (12) and qualitative (2) surveys.

The actual size of the database (40 publications) was determined by certain practical limitations – possibly excluding studies difficult to obtain or written in languages other than English and Italian – as well as by the usual time constraints.

Our summary of final rankings was organized according to the food attribute’s relevance in influencing consumer buying decisions, frequency of occurrence in the literature and absolute values reported for the attribute. Then, the reviewed studies have been classified according to the geographic context to allow for comparative analysis. Moreover, since the products the thesis focus on are small fruits obtained with alternative production methods, we devoted a subsection in analyzing attributes that were found relevant in previous studies for berries. Moreover, among all methods, we made a separate discussion for CE method (section 3.5), since it represents the latest step among the different stated preference techniques that have emerged within the field (Adamowicz et al. 1998; Bennett and Blamey 2001). It allows researchers to specifically investigate

[4] The review includes articles, papers, reports, conference proceedings, textbooks, dissertations, marketing and food studies.

trade-offs between several competing product attributes and to determine the relative importance of various attributes in consumers' choice process (Hanemann and Kanninen 1998).

5.3 Factors influencing the willingness to purchase and to pay sustainable F&V

According to the database of 40 studies, numerous specific attributes were found to influence consumer buying behavior and the willingness to pay for IPM, organically grown and other sustainably produced F&V. In categorizing attributes, experience related attributes that are clearly present in all foods are common, as are credence attributes. Table 2.1 lists all attributes described in details in the next paragraphs. Moreover, it reports how many studies have considered a particular attribute, how many have employed an econometric model and how many found that attribute significant at 5% level (or higher). In general, results show that the significance of attributes does not change using different evaluation techniques (quantitative methods, CV, CE). It seems that methodology affects the magnitude of these attributes, but not their significance.

Table 2.1. List of attributes and frequency of inclusion

Attributes List	Studies that considered attribute	Studies with econometric model	Studies reporting attribute significant at 5% level
Visual, smell and taste	24	3	1
Quality	6	1	1
Credence attributes			
Health related components			
Health	27	11	8
Pesticide free	14	2	2
Organic	16	6	3
Environmental attributes			
Environment	17	9	5
Origin	8	1	1
Local	9	-	-
Socially oriented attributes			
Support to farmers	5	1	-
Job creation	2	1	1
Credence related attributes			
Certification and other labels	11	8	6
Other attributes			
Brand	10	1	1
Packaging	2	1	-
Price	16	5	5

Before spelling out the role of these attributes, it is important to point out that in many studies that employ econometric models the researcher's attention is devoted to investigate the difference among different attribute levels and not to estimate the attribute itself. Moreover, it is important to keep in mind that consumer buying behavior and price sensitivity are also affected by other types of variables such as demographics (age, education, place of residence, income, marital status), biochemical factors for the product related to eating quality, neuro-sensory systems (Jacoby, 2002) and habits and life style (Govindasamy and Italia, 1998; Lohr, 2000; Cranfield and Magnusson, 2003; Magnusson and Cranfield, 2005; Midmore et al., 2005; Darby, 2006). From the review, some differ-

ences in WTP emerge according to whether the respondent buys organic F&V regularly or occasionally. In general, regular organic consumers are willing to pay a premium price that ranges from 17 to 67 % for organic fruit, and from 13 to 37% for organic vegetables, while occasional or unlikely consumers accept premiums ranging from 3 to16% for organic fruit and vegetables. So, the segmentation of customers appears to be warranted.

3.3.1 Visual, smell and taste components

A review of results show that, among the full set of factors, perceptions about eating experience components (visual, smell and aroma) are clearly among the most relevant and valued reasons for buying and being willing to pay more for sustainable F&V. Visual, smell and aroma components were often top rated among attributes listed, which is logical since they represent the basic components of eating pleasure (Zanoli et al., 2003; Ernst et al., 2006). According to these studies, organic and low environmental F&V are commonly bought since they are thought to be superior in terms of “flavour”, better, intensive, and authentic taste, good texture, and freshness.

Moreover, these components were commonly used as indicators about the overall product quality (Ness et al., 2010). The definition of “quality” is difficult to interpret as it involves various attributes that are closely interrelated with each other but go beyond taste, smell, color, size, firmness, and freshness. Only a few studies consider and define it in all its meanings (Lohr, 2000; Mabiso et al., 2005; Darby, 2006; Akgüngör et al., 2007; Ghorbani et al., 2007; Lili and Tong, 2007), while most researchers delineate a few specific aspects.

3.3.2 Credence attributes

3.3.2.1 Health related components

Together with visual, smell and aroma components, health related attributes are perceived by consumers as the most commonly reported significant reasons to buy sustainable food. According to this literature review, perceived quality differences in F&V can be linked to specific food components (artificial additives, genetically modified organisms), to the presence of nutritional components (rich in vitamins), and to the perceived risk associated with the use of agrochemicals. According to a large number of the studies, consumers perceive sustainable F&V as being natural, with higher vitamin and nutrient content, and containing fewer or no pesticides and additives compared to conventional F&V.

Overall, it seems that people are especially concerned with the potential harm that conventional food production practices may cause to their health, or to public health concerns (children, ill and elderly people; development of allergies in youth) (Midmore et al., 2005). Therefore, they are willing to pay a higher price to reduce the perceived direct and societal risk associated with the use of pesticides, GMOs and additives. According to Florax et al. (2005, 457), who conducted a meta-analysis, WTP for reduced risk exposure increases by approximately 15% and 80% in going from high to medium and high to low risk-exposure levels, respectively.

Related to risk concerns, “pesticide free” is perceived as another important attribute in consumer buying behavior as respondents were willing to pay a premium averaging 15% above the regular price to buy pesticide-free fresh F&V (Boccaletti and Nardella, 2000; Onozaka et al., 2006). Yet, consumers seem to be unconcerned whether the risk source concerns just one or a multitude of pesticides (Florax et al., 2005).

Organic certification appears to be similar to the pesticide free attribute, but less significant to the buying decision. One should note that the pesticide free attribute is

nested within organic since, by legal definition, no synthetic pesticides can be used in organic production. One possible rationale for why the organic attribute seems to be less important in the consumer's eyes (compared to the less restrictive claim of pesticide free) may be the complexity surrounding organic labeling (Rizzardi, 1997). Past studies also concluded that consumer's perceptions that organic products are only food for babies or sick people (Piraccini, 2000), or that poor product availability in supermarkets limited information and the consumption experiences at the time of studies (Boccaletti and Nardella, 2000: 298). According to the latter study, consumers often doubt the existence of "truly organic" F&V.

Moreover, those who have knowledge of sustainable practices (organic, IPM) and have made previous purchases are more likely to buy IPM grown F&V, and are willing to pay a premium of six percent or higher (Govindasamy and Italia, 1998; Richter et al., 2000; Cranfield and Magnusson, 2003). According to Boccaletti and Nardella (2000) - who found that knowledge of negative pesticide effects was not significant - the lack of credibility and differentiation of certified products, or limited consumption experience, are likely causes. Continued education and credible 3rd party certification processes appear to be needed if food retailing enterprises intend to effectively market such claims.

5.3.2.2 Environmental attributes

A significant number of studies have specifically analyzed the relevance of environmentally related attributes (increased biodiversity, ecosystem protection and natural system conservation). They range from somewhat important to important across consumer studies. Louriero et al. (2001) - who studied the WTP for sustainable and organic apples versus conventional ones - found that consumers with strong environmental attitudes have the largest demand for food grown by producers with a strong commitment to

environmentally friendly practices. However, other studies suggest that the coefficient on environmental concern is the least important (Scarpa and Spalatro, 2001) or insignificant in the WTP regression, after controlling for consumption behavior and demographic characteristics (Hamilton et al., 2003).

5.3.2.3 Origin, Local and farmers' support

Attributes referring to products' origin are found to be either important, or somewhat important in a majority of the studies. The attribute "local" involves a bundle of other aspects, private and public, which a consumer may perceive to be interrelated with each other, such as aroma components, environmental concerns and the intention to support the local economy of the home region.

According to our analysis, the attribute local generally seems to be relevant to the decision to buy fresh F&V. Local products are assumed to be fresher and better tasting and, most importantly, they may enhance the trust of consumers who personally know the producers of their fruit and vegetables (Midmore et al., 2005; Rodriguez-Ibeas, 2007: Thilmany et al., 2008). Moreover, according to Marchesini et al. (2007, p. 7), the shorter the distance between producer and consumer (geographically and culturally speaking), the higher the effectiveness of local geographical indicators. Bond et al. (2007) note that intended support for farmland preservation is significantly linked to those who pay a premium for local produce.

Socially oriented attributes of production systems do not seem to affect the consumer decision in a significant way. Although consumers appear concerned with sustainability and economic support of local or small farmers and the creation of employment in rural areas, those who are more likely to pay a higher premium for sustainable products may not prioritize such claims. Across the findings reviewed, the magnitudes of the mar-

ginal effect of such factors are small (Cranfield and Magnusson, 2003; Akgüngör, 2007) or insignificant (Magnusson and Cranfield, 2005). As one exception, when consumers are solicited about buying and paying decisions for local (Darby, 2006; Henseleit et al., 2007) or organic foods (Bond et al., 2007), "help local farmers" was an important determinant (Richter et al., 2000). In short, it appears that the support for farms may be nested into other product claims.

5.3.2.4 Credence related attributes: Certification and other labels

Consumers often use 3rd party certification or labels as safety and quality cues for attributes that require oversight by knowledgeable experts (Lohr, 2000). Several studies suggest that the lesser importance placed on certification labels could be due to the lack of clear procedures that implicitly guarantee the credence attribute, such as safety (Boccaletti and Nardella, 2000; Midmore et al., 2005; Zanoli et al., 2007). For example, most Italian consumers do not trust labels because they do not perceive the existence of standardized certification procedures (Pirani and Re, 1999). Also, due to past food scandals (BSE, dioxin contamination of Belgian food), labeling products to certify organic or low input production is no longer a guarantee in and of itself (Lohr, 2000). In a broader context, the complexity and ambiguity behind a certification process may also be part of the rationale for this consumer response.

However, among certifications, Eco-labels seem to provide the most effective market signal (Loureiro et al., 2001; Mabiso et al., 2005; Marchesini et al., 2007; Rodriguez-Ibeas, 2007). Eco-labels for fresh apples and tomatoes showed a price premium of between $0.10 and $0.50 per pound (Loureiro et al., 2002; Mabiso et al., 2005). Moreover, Marchesini et al. (2007) found that the appreciation of eco-labels varies significantly between countries: the premia attached to bundled GI (Geographical Indicators)

ranges from 10-30% and 10-50% (up to +100%), respectively. They report that the deciding factor explaining increased levels in WTP appear to center around a perceived increase in food safety and quality, especially for fresh and perishable products.

Labels referring to production origin is generally ranked, rated or estimated among the somewhat or less relevant factors to the buying or paying decision (Zanoli et al., 2003; Campbell et al., 2004; Midmore et al., 2005; Darby, 2006; Poole and Martínez-Carrasco, 2007). Mabiso et al. (2005) found that origin labels garner a premium, while Scarpa et al. (2005) found that the WTP for origin depends on the product under question. Regarding the relevance of this attribute, Bureau and Valceschini (2003) report an interesting finding: higher demand for certification is requested by consumers who live further from the production site than those living closer (Marchesini et al., 2007). In short, 3rd parties may be more essential when distance makes information gathering more difficult.

5.3.3 **Other attributes**

Branding seems to be less important in determining consumer buying decisions given insignificant results for this attribute (Mellor et al., 2002; Darby, 2006; Thilmany et al., 2006; Poole and Martínez-Carrasco 2007). Packaging is considered in only two studies with insignificant results.

Finally, price does still matter. According to the review's results presented in Table 1, although people do not mention price directly as an obstacle to purchases, the price of sustainable products might be a barrier (Roitner-Schobesberger et al., 2008), even though a higher prices could be seen as a signal of the higher quality given the relative importance of value in several studies (Zanoli et al., 2003).

5.3.4 Relevant attributes for berries

Visual and smell components, pesticide free and local production are the top ranked attributes that influence the purchase and consumers' willingness to pay for berries, followed by certification, origin and organic (Mellor et al., 2002; Scarpa and Spalatro, 2001; Ernst et al., 2006; Della Casa, 2005; Darby, 2006). Brand, price and environment are instead the less important attributes. Pesticide free attribute is a particularly important determinant in case of strawberries, given that this fruit has been rated as one of the top six most tainted foods (Environmental Working Group, 2006). Moreover, for locally grown strawberries, consumers are willing to pay around $ 1.00 on average more than the berries identified simply as "produced in the U.S." (origin). This result confirms, once again, the importance of a direct contact between consumers and producers. Regarding blueberries, a specific study made by the US Highbush Blueberry Council (USHBC, 2004) reveals the health attribute is the most important one, followed by the visual and smell components, certification and price.

5.3.5 Relevant attributes and Choice Experiments

After the analysis of the differences in attribute relevance, we focused on a sub-sample of nine reviewed studies, specifically targeting those applying the Choice Experiment approach.

The task to identify the attribute relevance becomes quite easy since parameter estimates allows one to calculate the implicit price for each attribute present in the choice set. The reported studies are driven in Canada, in USA, and Italy.

Seven attributes were found to be strongly determinant: pesticide free, environmental preservation and conservation, local, visual & smell, health, quality and price (Table 2.2). Certification, origin, organic and brand name were found to be only

occasionally significant, while support for farmers was considered less determinant. This result is quite unexpected given the more consistent results associated with the attribute local, but suggests a need to better understand interrelated aspects such as health nutrition, environmental concerns and the willingness to support the local economy of the home region, that could indirectly increase a local claim's relevance in buying decision.

Table 2.2. Relative importance of attributes in Choice experiments studies

Relevance	**Attribute**
Strongly Determinant[a]	Pesticide free Environment Local Visual & smell Health Quality Price
Somewhat determinant	Certification Origin Organic Brand
Less determinant	Support farmers

[a] in decreasing order of importance

5.4 Relevant attributes and countries

After the identification of the determinants of consumers buying and WTP for sustainable F&V, we analyze similarities and differences in attribute relevance that occur in different countries where studies have been done. All mentioned attributes were grouped into three categories - strongly determinant, somewhat determinant, and less determinant - according to the statistical relevance of the attribute in different types of survey, to the frequency of inclusion and when estimated, to the reported coefficient of the attribute.

Three different macro regions have been identified: USA, Europe (plus some countries of the Middle East) and Eastern Asia/Pacific Rim, including China and Thailand. According to our study, only the health-related attributes are found to be an important factor common to all the three areas. Otherwise, the relevance of attributes seems to be differentially valued depending on the area studied.

Most studies investigated US consumers' purchase and payment behavior, especially for apples, berries and vegetables. In the USA and Canada, willingness to buy and pay seems to be determined by both private (health and food) characteristics, and credence attributes (environment and support farmers) that, more or less, have the same weight. The organic seal, price, and 3rd party certification are somewhat important, while brand and origin were the attributes that least affect the WTB and WTP. A few things are interesting to note. First, US consumers perceive pesticide free and organic differently, and second, organic claims are only somewhat important (Table 2.3). This may suggest that organics are still not well understood by consumers.

Table 2.3. Relevance of attributes according the country where the study has been done.

Country	**USA, Canada, Argentina, Australia**	**Europe**	**East Asia/ Pacific Rim (China, Thailand)**
Attribute relevance[a]			
Strongly determinant	Health Visual & Smell Environment Pesticide free Local Farmers' support Quality	Health Visual & Smell	Health Environment
Somewhat determinant	Organic Price Certification	Environment Pesticide free Certification Origin Quality	Visual & Smell Pesticide free
Less determinant	Brand Origin	Local Organic Brand Farmers' support Price	Price
Not investigated	Creation of employment Packaging Availability	Creation of employment Packaging Availability	Certification Origin and Local Support farmers Creation of employment Brand Availability

[a] in decreasing order of importance

In Europe, greater significance is given to experience features and to health related components, while credence attributes (environment and support farmers, origin, local, organic) or of somewhat limited or little importance. This result is quite unexpected given the effort of European Union's Common Agricultural Policy (CAP) to introduce sustainable practices among growers and to increase peoples' sensitivity to environmental and social issues linked to agricultural practices in rural areas.

Regarding the third region (Eastern Asia/Pacific Rim region), health and environment attributes constitute the strongest determinant, followed by visual & smell components and the pesticide free attribute. It is worth noting that only a few attributes (6) are even taken into consideration by studies in this area when compared to the US (13) and European (12) areas, possibly signaling that developing countries with broader food security issues may consider some credence attributes as origin, local, support farmers, certification, less essential than sufficient quantities and dietary needs.

Besides these macro regions differences, other difference exist inside each region, nevertheless a direct comparison is challenging to interpret given that these differences depend not only on the product evaluated - but also, the diversity of attributes investigated and cultural and socio-characteristic of the sample. This latter aspect is particularly true for Europe, where each country has a unique food culture and tradition

5.5 Implications for Sustainable Food Industry Managers

5.5.1 Assessing the Role of Private vs. Public Attributes

The review shows that, even if consumers assign a high value to credence attributes that are at least indirect related to public goods (environment and biodiversity conservation, economic support of local or small farmers, job creation in rural areas), their choice to buy and WTP for fresh F&V is primarily driven by attributes involving private good features associated with own health issues or food as enjoyment (Michelsen et al., 1999; Loureiro et al., 2001; Cranfield and Magnusson, 2003; Hamilton et al., 2003; Canavari et al., 2005; Magnusson and Cranfield, 2005; Midmore et al., 2005; Bond et al., 2007).

This result could be due to the fact that consumers are less familiar with credence public attributes, or uncertain that their buying choices will affect outcomes in the public

realm. This uncertainty surrounding some product attributes at the time of purchase can lead to a mismatch between purchase and consumption preferences (Poole and Baron, 1996; Poole et al., 2007). In addition, besides public good aspects being extremely difficult to evaluate, they are bound by highly subjective and often relatively vague, especially given the wide range of beliefs and principles in the socio-economic and environmental context (Midmore et al., 2005, 8).

5.5.2 Marketing Challenges for Credence Attributes

Credence attributes are characterized by a higher dependency on 3rd party information (Röhr et al., 2005) but this summary of findings suggests that the average consumer does not highly value the quality and safety certification processes (Blend and van Ravenswaay, 1999; Zanoli et al., 2007; Roitner-Schobesberger et al., 2008). Among credence features, "local" is always ranked higher than organic, certification, origin, even with no clear definitions or regulating body in place to monitor such claims. This result suggests that the attribute local might be interpreted by consumers as an implicit guarantee or direct assurance which they view as better than a 3rd party certification. For now, a personal assurance from the producers of fruit and vegetables appears to enhance the consumers trust in this type of food (Midmore et al., 2005; Rodriguez-Ibeas, 2007, Thilmany et al., 2006) more than a certification. Therefore, improving the contact between the producer/seller and the consumer, for example, through marketing foods at the farm gate, at direct markets or specialty stores where consumers and producers may interact (Midmore et al., 2005; Thilmany et al., 2006) could be an effective strategy for small firms. Finally, comparing WTP motivations for organic food vs local food Bond et al. (2007) found that supporting local farmers is a more powerful motivator than supporting natural systems. The challenge associated with the attribute local is to better communi-

cate interrelated aspects such as health nutrition, environmental concerns and the willingness to support the local economy of the home region that could indirectly increase a local claim's relevance in buying decision.

Mistrust in certification is reported by Röhr et al. (2005: 652) who found that German consumers perceive information provided by consumer or environmental organizations, nutritionists or physicians as more trustworthy than information from the Ag Ministry, food producers or the media. It may due to recent food scandals that fueled a certain degree of uncertainty about the oversight of the food marketing system (Midmore et al., 2005).

Solutions to increase the value of certifications may include providing more reliable information about the certification processes' connection to sustainable outcomes (Hamilton et al., 2003; Röhr et al., 2005; Zanoli et al., 2007). Local could be viewed as a threat to more structured food certification programs that are based on scientific standards, production plans and regulatory oversight. But, marketing these new generations of grades and standards effectively may be challenging given what consumer research signals about current interest in these programs.

5.5.3 Lessons for Future Consumer Research

On the basis of the literature review, we can provide some guidance for future research.

Preferences for organic food have been widely studied, while research into consumer response towards IPM or other sustainable practices is scarce in the literature (Govindasamy and Italia, 1998; Loureiro et al., 2001; Scarpa et al., 2005). This agricultural practice is often neglected compared to the more commonly known organic standard, but

in many circumstances it remains the only feasible option for some producers[5], and may be more attractive to consumers given the clarity of its intended outcome. Given this inference that clear outcomes may matter to consumers, and growing interest in climate change, research on consumer valuation of lower carbon footprints, life cycle analysis and carbon offsets seem warranted.

No direct attention has been devoted in the reviewed studies to the distinction between tangible and intangible attributes, especially in revealed vs. state preference studies; a shortcoming that could be addressed as auctions become more prevalent. As demonstrated by Horscky et al. (2004) in relation to wine preferences, tangible attributes (price and performance in their study) are weighted relatively more than intangible attributes (such as the prestige) in actual choice vs stated preferences. Actually, as (Horsky et al., 2004) stated, when you ask people what they would like, they answer ideally by pointing to the label of high-price or high-prestige option, but in reality, they will proceed to do what makes most sense for their wallet (Horsky et al., 2004: 138). Choice experiments rather than contingent valuation methods may also make such comparisons of individual attributes possible.

Besides these research areas, review identifies some limitations and methodological issues encountered in the analyzed studies, with particular attention devoted to CE. Here follows a list.

[5] In Michigan, for example, most blueberry production is undertaken with conventional pest management, while organic production is around 0.1-0.4% of total production. Due to Michigan's specific climatic characteristics, it is impossible to adopt organic production without incurring huge losses and low quality. Thus, in order to reduce the use of chemicals and to produce in a more sustainable way, Michigan State University undertook a project, RAMP, designed to measure the changes in blueberry pest management systems when broad-spectrum insecticides are replaced by an IPM scouting program and reduced-risk insecticides (Mark Longstroth, Isaacs Rufus, Dave Trinka, June 2007, personal interviews).

1. Comprehension of environmental and social attributes by respondents depends on the definitions (or not) provided in the survey. Information does matter and should be as objective as possible. Varying definitions of credence attributes makes comparative analysis difficult.
2. The relevance of some attributes as "food safety" may strongly depend on the context and on the time the survey has been taken. At a national level, consumers may take this attribute for granted if they perceive that the food safety regulation has been respected from producers and traders (Canavari et al., 2010). However, its relevance may change when a food scandal occurs, becoming one of the most important attribute.
3. The effect of information on the WTP and WTBuy for food with credence based is only starting to be investigated and tested. When designing any survey, and in particular a CE, this effect should be vetted in focus group processes to develop research instruments since WTP estimates highly depend on the amount of information presented to respondents in the survey (Wier, 2007). Wier (2007) highlighted that studies about sustainable food provide information about the sustainable practice before the CE is carried out, but they rarely measure the effect of the provision of this additional information.
4. Many attributes investigated in the studies interact with each other and might even overlap: (e.g. origin, production type, and taste). As these attributes are not separable in a controllable way, it becomes important to clearly present the attribute description and control for interactions in the statistical design. For example, a clearer definition of Local is needed in order to avoid some inferences that respondents could make and to have more efficient WTP values. Darby et al. (2008) addressed this issue by decomposing the local attribute into two degrees of

distance and by distinguishing factors that are often associated with Local, such as farm size and freshness, and founded that demand for locally produced food is independent of these attributes.

5. In specifying attributes in a CE, it is also important to select appropriate levels, since they may capture hidden information, influence credibility in the eye of the respondents and eventually limit the domain of potential results.
6. Many of the reviewed studies, and in particular, those that employed a CE, addressed the role of processing information within consumers' food choices. Thus, it appears to be crucial to account for differences in attribute processing strategies, both across respondents and across choice tasks, since failure to account for such heterogeneity can lead to biased WTP estimates (Hensher, Quiggin, 2006; Hensher, 2006).
7. Surprisingly, few studies in the literature review examined the existence of lexicographic preferences[6] in general or for one attribute. In evaluating WTP for a credence good through a CE, lexicographic preferences should be taken into account, given the amount of evidence supporting their existence for public attributes such as environment and biodiversity conservation, or economic support of local or small farmers (DeShazo and Fermo, 2002; Rosenberger et al., 2003; Campbell et al. 2006). Failure to account for lexicographic preference, will cause a violation of the continuity axiom for environmental goods (Rosenberg et al. , 2003; Campbell et al., 2006) and a departure from the use of compensatory decision-making, ultimately leading to biased WTP estimates (Campbell et al., 2006). One strategy to deal with lexicographic behavior is to use debriefing questions,

[6] According to Rosenberger et al., (2003), a person who has lexicographic preferences bases her response according to a hierarchy of values and she is generally unwilling to trade or accept compensation for changes in a good or for a specific attribute at all. That is, for this person there is not a reservation price at which he/she is willing to trade the good. For the sake of clarity, this person will always prefer a certain good to all quantities or qualities of other goods.

where respondents are asked to give reasons why they, for example, focused on only one or two of the attributes in the choice experiment (Alpizar et al., 2001; Rosenberg et al., 2003).

8. A shortcoming of using stated preference technique is that in these surveys respondents generally report higher hypothetical than real willingness to pay: in short, a "hypothetical bias". Using a mixed approach that investigates both stated and revealed preferences could be very helpful in understanding actual consumer preferences for food and to test choice consistency.

5.6 Conclusions

In a review of 40 studies, this research provides an overview of attributes which drive consumers buying behavior of sustainable fruit and vegetables. The review confirms that the choice to buy and WTP for fresh F&V is primarily driven by attributes involving private good features associated with own health issues or eating quality. Analyzing similarities and differences across countries highlights that only health related aspects are similarly valued across regions, while the importance of others attributes varies considerably.

Interestingly, results show that the attribute "Local" is increasing in relevance when compared to organic, certification, and origin. This may indicate that consumers interpret the attribute local as an implicit quality guarantee, or at least more than a 3rd party certification. Future research should be devoted to understanding the claims used for credence attributes, perceptions about the expected outcomes and marketing strategies that enhance trust and loyalty toward sustainable products. In short, targeting motivated consumers, positioning brands and communication strategies for organic and low

environmental impact food should focus on convincing consumers that these attributes confer a value added to the consumer, even if the value relates to a broader public good aspect of the food and its production system. Currently, direct marketing in localized food systems is "winning" this challenge in the eyes of consumers, but many challenge whether local food systems can be sustained or grow much further given global food security concerns.

Finally, the review provides a discussion on important consumer research questions and draws some implications useful for agribusiness researchers. If the aim is to improve marketing strategies on existing or new sustainable products, a better understanding of interactions among claims, how consumers process information on product certification and perceptions about credence attribute outcomes seems warranted.

Chapter 4

A cut-off approach incorporating context effect to estimate consumer' preferences for small fruits obtained with alternative production methods

4.1 Introduction

Economists, psychologists, and marketers have long investigated the decision processes used by people to make choices or to consider choice tasks (Bettman and Kakkar 1977; Jacoby et al. 1977; Simon 1983; Payne et al., 1992; Harte and Koele 2001; Hensher et al., 2005b; Hensher, 2006a, 2007; Hensher et al., 2007). In choice modelling, it has often been assumed that respondents consider all the attributes presented to them, as if all of these somehow influence their choice (Kaye-Blake et al., 2009). However, this assumption could lead to inaccurate results and biased estimates of marginal utilities of attributes (Puckett and Hensher, 2008; Kaye-Blake et al., 2009). Research in psychology and consumer behaviour has indeed long suggested that individuals react to increasingly complex choice situations by adopting non compensatory models and simplifying strategies (Simonson and Tversky 1992; Swait and Adamowicz, 2001a, 2001b; DeShazo and Fermo, 2004; Hensher et al., 2007; Scheibehenne et al., 2008).

Respondents may not consider all the attributes in a survey by ignoring one or more attributes (Hensher et al., 2005b; Rose et al., 2005), by using cut-off based heuristics in making decisions defining minimum or maximum levels of acceptability (Swait 2001; Cantillo and de Dios Ortuzar 2005), by employing cognitive short-cuts to limit task complexity (Gabaix and Laibson 2000; Yamamoto et al. 2002) and by combining attributes in non-linear ways (Sethi and King 1999; Gilbride and Allenby 2004, Kaye-Blake et al., 2009).

That is, respondents make use of non-compensatory decision rules, such as conjunctive and disjunctive ones (Elrod et al., 2004), elimination by aspects (Tversky, 1972), and lexicographic rule (Wright, 1975) to reduce the cost of making decisions or achieve a determined utility level (Swait, 2001). Deviations from the fully considered attribute assumption may be due to previous learning, cognitive difficulties in processing and integrating the information, constraints of time and cognitive abilities (Simon 1955, Gilbride and Allenby, 2004; Louviere et al. 2005, Kaye-Blake et al., 2009). Blamey et al. (1997) and Kjaer et al. (2006) provide an overview of the different decision strategies and heuristics that can play a role in Choice Experiments (Glenk, 2007).

Among the several heuristics used by consumers to simplify their decision making, the use of threshold values is widely recognised in literature (Svenson, 1996, Swait, 2001, Elrod et al., 2004) and analysis of synthetic data shows that ignoring the presence of thresholds in datasets containing them leads to significant errors (Cantillo et al. 2006; Kaye-Blake et al., 2009). Different choice models studies exist that take into account cut-offs (Gensch & Svetska, 1979; Rotondo, 1986; Manrai & Sinha, 1989; Swait, 2001, Cantillo and de Dios Ortuzar 2005; Cantillo et al. 2006; Martinez et al., 2009). Swait (2001) defined two types of cut-offs: hard and soft. *Hard* cut-offs are attribute levels that must be reached, or alternatively not violated, to allow a valid choice.

Lexicographic preferences[7] represent the extreme case. (Tversky, 1972; Manrai and Sinha, 1989). Including hard cut-offs in the choice modelling framework requires adding further constraints that prevent respondents from choosing an alternative that violates any of their stated cut-offs (Bush et al., 2009). Since it has been demonstrated that respondents often violate their stated cut-offs (Huber and Klein, 1991; Green et al.,1988; Swait, 2001), the concept of *soft* cut-offs has been introduced as an attempt to overcome the issue of cut-off violation. According to Swait (2001), a respondent may violate the stated cut-off for single attributes because he/she evaluates the overall benefits associated with the bundle of attributes represented in that particular alternative. More precisely, an individual may prefer to suffer a potential cost (penalty) associated with cut-off violation rather than disregarding that particular alternative. So far, Swait's approach has been applied in transport economics (Danielis and Marcucci, 2007; Marcucci and Gatta, 2009), in agricultural and natural resource economics (Bush et al., 2008, 2009) and in food economics to estimate consumer preferences for beef (Aizaki et al., 2009) and for functional food (Ding et al., 2010). Utilizing the soft cut-off approach in choice experiments implies asking respondents to explicitly declare their cut-offs. This implies opening the path to incorporate information gathered by stated thresholds into discrete choice modelling.

In this study, we exploit this information to empirically investigate context dependencies in consumer market behaviour. Since consumer choices are at least partly driven by the context provided by the set of alternatives (Rooderkerk et al., 2009), we propose a discrete choice model that extends Swait's (2001) cut-off approach by incorporating cut-off violations as context effects. The novelty is that the consumer's utility asso-

[7] General unwillingness to trade or accept compensation for changes in a good or for any specific attribute at all (Rosenberger et al., 2003).

ciated with an alternative depends not only on the violation of threshold values in that alternative, but also on violations that occur in competing alternatives.

To the best of our knowledge, this is the first Choice Experiment on food to have focused on the analysis of cut-off violations as context effects. Moreover, the research differs somewhat from previous studies investigating consumer preferences for food obtained by employing alternative production methods. In addition to conventional and organic production, we in fact scrutinized preferences for integrated pest management (IPM), for a more innovative IPM technique that employs biocontrol agents extensively and for the adoption of mitigation farming practices that aim to reduce greenhouse gas emissions. Other investigated attributes were appearance, origin, and price.

The remainder of the chapter is structured as follows: section 2 reviews the main examples of context dependencies, section 3 describes our approach to incorporating context effect, section 4 describes the method (a choice experiment) employed, the experimental design, and the data; Section 5 presents the results; Section 6 discusses the findings, concludes and draws practical implications for further research.

4.2 Context dependencies

Over recent decades, there has been increasing interest in analyzing the influence of context on human decision making (Swait et al., 2002). A wealth of literature exists in psychology and behavioural decision theory (e.g., Tversky & Shafir 1992; Bettman et al., 1993; Dhar, 1997a, 1997b; Swait and Adamowicz, 2001a), but also some studies exist in economics (e.g., de Palma et al., 1994; Heiner, 1983, De Shazo and Fermo, 2002), showing that consumers' choice is often influenced by decision context, defined by the set of alternatives under consideration (Payne 1982; Simonson, 1989; Simonson and Tversky, 1992; Payne et al., 1993, Chernev, 2005) or by decision environment and task complex-

ity (Dhar et al., 2000; Swait and Adamowicz, 2001a; De Shazo and Fermo, 2002; Köster, 2003**).**

The first evidence of context effects was documented by Lichtenstein and Slovic (1971), Kahneman and Tversky (1979) and Tversky and Kahneman (1981), who reported the existence of preference reversals, framing effects, and loss aversion[8]. Since then, these and many other effects have been widely proven in different fields and settings (Camerer 1995; see Swait et al. (2002) for a list of the most known context dependencies found in literature)[9]. Most of all, particular attention has been devoted in literature to the compromise effect (Simonson 1989), the attraction effect (Huber et al., 1982; Huber and Puto, 1983) and the similarity effect (Tversky, 1972, Malkoc, 2008; Rooderkerk et al., 2010)[10].

[8] Preference reversal refers to the phenomenon that in comparing two gambles, the subjects' order of preferences vary depending on the elicitation task used (for example, whether the task involves choice or ratings (Nowlis and Simonson, 1997). Framing can be considered an extreme example of context-dependence, where preference reversal occurs by simply modifying the description of (otherwise identical) sets of alternatives (a famous example is the ''Asian disease'' experiment" (Tversky and Kahneman's, 1981; Tversky and Kahneman, 1991). Loss aversion is a special case of reference-dependent preferences, where people are significantly more averse to losses (compared to the reference) than they are attracted to same-sized gains. In a context of choice between alternatives, loss aversion refers to the phenomenon that individuals tend to weigh disadvantages more heavily than corresponding advantages when evaluating different options (Devetag, 1999).

[9] Swait et al. (2002) provided a list of the most known context dependencies found in literature as habit or experience dependence effects, social interdependence, accountability effects, menu-dependence, chooser-dependence, mental accounting, choice bracketing, motivation effects, decoy effects, reference prices, and complexity effects.

[10] The compromise effect refers to the phenomenon that the choice share of an alternative increases when it is the compromise option in the choice set (Simonson 1989). Individuals seem to avoid options that present extreme values, preferring instead options that represent a compromise between two extremes. The attraction effect occurs when an item increases the favourable perception of similar, but superior, items in the choice set (Huber et al., 1982); while similarity effect occurs when the addition of an alternative harms similar alternatives more than those that are dissimilar to it (Tversky, 1982).

In stated preference research, context effects have been investigated analyzing the influence of choice complexity on individuals' decision-making behaviour. That is, the influence of different survey design factors, independent of the respondent's characteristics, such as the number of choice tasks, alternatives, attributes per alternative, attributes that are constant across alternatives, and the range of attribute levels (Duquette et al., 2009). In making choices, individuals may focus their attention on certain aspects of the alternatives and in particular on the value that an option has in relation to the other options in the choice set (Simonson & Tversky, 1992). However, this focusing on local comparison of the alternatives ignoring at the same time a more global assessment increases the choice complexity (Simonson and Tversky, 1992; Dhar et al., 2000). This alters the degree of attention to local versus global aspects, and thus has an impact on the degree of decision difficulty (Dhar et al., 2000), leading individuals to adopt simplifying strategies (Heiner, 1983; Swait and Adamowicz, 2001a) and/or to make inconsistent choices (Dhar et al., 2000; Duquette et al., 2009). DeShazo and Fermo (2002) and Hensher (2004, 2006a) found that survey design elements systematically impact on choice consistency via the scale of the error term in a random utility model. Finally, playing an important role in the respondent's decision making process, context and choice complexity impact on the marginal utility estimates and consequent willingness to pay calculations (Louviere, et al. 2005; Adamowicz and DeShazo, 2006). Therefore, since context may lead individuals to use simpler choice heuristics (Swait and Adamowicz, 2001a) researchers should explicitly seek to incorporate context effects into choice modelling (Payne et al., 1999; Swait et al., 2002). Not taking into account or ignoring context influences on choice behaviour may lead to neglecting some effects on choice set formation, constraints, evaluation rules and decision rules and therefore obtaining biased estimates (Payne et al., 1999) with practical implications for marketers who may adopt misleading

marketing strategies (Adaval and Monroe, 2002; Nowlis and Simonson, 2000; Busemeyer et al., 2007).

In our model, we aimed to capture the impact of context on the individuals' choice. In detail, we focus on understanding whether the choice of an alternative is influenced by cut-off violations that occur in competing alternatives, besides the violation of threshold values in that alternative. The logic behind this is the following: since consumers state for each alternative some minimum or maximum requirements for each attribute they will evaluate all alternatives relative to these thresholds to determine how far they are on a particular attribute before making the choice. Therefore, violations occurring in directly competing alternatives should be considered.

4.3 Description of the model

We investigated the effect of individual thresholds on consumer choice behaviour within the framework of the random utility model (RUM) developed by Thurstone (1927), Marschak (1960) and McFadden (1973).

The RUM structure proposes that the utility (U_i) associated with an alternative, *i*, evaluated by individuals in choice situations can be divided into the contributions that are observed, V_i, and those that are not, ε_i, and further that U_i is the sum of these two components $U_i = V_i + \varepsilon_i$.

The utility generated by each alternative *i* described by *k* attributes (X_k), is represented by the following well-known expression:

$$U_i = \sum_{k=1}^{k} \beta X_k + \varepsilon_i$$

where

- X_k is the vector of known explanatory variables, including attributes (also price) of the alternatives,
- β is a vector of taste parameters over the population that varies across individuals,
- ε_i is an error term usually assumed to be Extreme Value type I distributed,
- β'_i and ε_i are not observed by the researcher and are treated as stochastic influences.

In a choice set C, several alternatives are presented to a respondent *n*. According to the RUM, the individual *n* selects the alternative *i* that provides the greatest utility. More specifically, since the individual tries to maximize the utility he/she can obtain from his/her choice subject to an income constraint Y, the utility maximization problem becomes:

$$[\text{Max}]\ U_i = \sum_{i \in C} \delta_i\, U(X_k) \qquad (1)$$

$$\text{s.t.} \sum_{i \in C} \delta_i = 1,\ \delta_i = 0, 1,\ \sum_{i \in C} \delta_i p_i \leq Y_{n,}\ \forall i \in C,$$

where δ_i is a choice indicator equal to 1 if respondents choose the alternative *i* and 0 otherwise.

According to Swait's (2001) "soft cut-offs" approach, we can introduce the information regarding thresholds into the deterministic part of the utility function.

The attribute cut-offs stated by the respondents for each attribute *k* and for the alternative *i* can be expressed as lower (a_{ik}) and upper (b_{ik}) bounds, k=1,…,K-1, where $-\infty < a_{ik} \leq b_{ik} < \infty$, and lower and upper price c_i and d_i for p_i $\forall i \in C$, where $-\infty < c_i \leq d_i < \infty$.

In order to represent the amount by which the cut-offs are violated in choosing alternative *i*, we need to associate two new variables to the cut-offs: $\lambda_{ik} \geq 0$ for the lower limits and $\gamma_{ik} \geq 0$ for the upper limits ($\forall i \in C$, $k=1,\ldots, K$).

Then, for each attribute in each alternative, violations can be defined as

$\delta_i (\theta_{ik}^L - X_{ik}) - \lambda_{ik} \leq 0$ and $\delta_i (X_{ik} - \theta_{ik}^U) - \gamma_{ik} \leq 0$

where δ_i is a choice indicator equal to 1 if respondents choose the alternative *i* and 0 otherwise and θ_{ik}^L and θ_{ik}^U are two vectors defined as

$\theta_{ik}^L = [a_{i1}\ a_{i2} \ldots a_{iK}\ c_i]'$, $\theta_{ik}^U = [b_{i1}\ b_{i2} \ldots b_{iK}\ d_i]'$.

The cut-off violation for quantitative attributes preserves its quantitative nature, that is $\lambda_{ik} = \max (0, \theta_{ik}^L - X_{ik})$, $\gamma_{ik} = \max (0, X_{ik} - \theta_{ik}^U)$. The cut-off violation for qualitative attributes causes marginal utility to drop discontinuously (Swait, 2001; Danielis and Marcucci, 2007). This is done by transforming it into a dummy variable, that is λ_{ik} and γ_{ik} are equal to 0 or 1 depending on whether the stated cut-offs have been violated or not but in this way we lose the information about the intensity of the cut-off violation.

According to the Swait model, if the level of an attribute does not satisfy the stated threshold value, then the respondent has two alternatives: to choose the null option or to violate his/her stated threshold. Cut-off violations signal that the respondent may prefer to suffer the potential cost associated with cut-off violation rather than giving up that particular alternative. This potential cost can be introduced into the model as utility penalties associated with cut-off violations.

The consumers' optimization problem in incorporating cut-off violations and associated utility penalties therefore becomes the following:

$$\text{Max } U_{pi} = \sum_{i \in C} \delta_i U_i (X_{ik}) = \sum_{i \in C} \delta_i (\beta_{ik} X_{ik}) + \sum_{i \in C} \sum_{k} \delta_i (w_{ik}\lambda_{ik} + v_{ik}\gamma_{ik}) + \varepsilon_i \qquad (2)$$

$$\text{st.} \sum_{i \in C} \delta_i = 1, \delta_i = 0, 1, \sum_{i \in C} \delta_i p_i \leq Y_n,$$

$$\delta_i (\theta_{ik}^{L} - X_{ik}) - \lambda_{ik} \leq 0 \; , \; \delta_i (X_{ik} - \theta_{ik}^{U}) - \gamma_{ik} \leq 0,$$

Then, for each attribute in each alternative, violations can be defined as

$$\delta_i (\theta_{ik}^{L} - X_{ik}) - \lambda_{ik} \leq 0 \text{ and } \delta_i (X_{ik} - \theta_{ik}^{U}) - \gamma_{ik} \leq 0$$

$$\lambda_{ik} \geq 0 \; , \; \gamma_{ik} \geq 0, \; \forall i \in C \; ,$$

where:

- U_{pi} is the penalized utility,
- δ_i a is a choice indicator equal to 1 if respondents choose alternative *i* and 0 otherwise
- X_{ik} is a vector of attributes describing the alternative i,
- λ_{ik} and γ_{ik} represent the amount by which the cut-offs are violated in choosing alternative *i*, for the lower limits and for the upper limits respectively. Both are ≥ 0. If no violation occurs, (λ_{ik} and γ_{ik} equal to zero) one returns to the basic model.
- w_{ik} and v_{ik} are the marginal disutilities of violating respectively the lower and the upper stated cut-off values. In this specification, the w_{ik} and v_{ik} parameters should not be positive, indicating decreasing marginal utility when the attribute level exceeds the cut-offs.

The magnitude of the estimated penalties w_{ik} and v_{ik} reveal compensatory or non-compensatory decision strategies. Estimated coefficients which tend toward zero imply that the attribute cut-offs play no role and the model becomes a compensatory model. Significant cut-off coefficients might indicate respondents follow conjunctive or disjunctive decision making rules.[11]

[11] The conjunctive decision rule entails rejection of any alternative that does not meet the minimum level of desirability of any one of the attributes (Elrod et al., 2004). That is, an alternative to be considered has to

When the coefficient of a penalty, w_{ik} and $v_{ik,}$ proves to be extremely negative, respondent *n* follows a "hard" conjunctive decision strategy, signalling that that cut-off is extremely important for her (Swait, 2001; Marcucci and Gatta, 2009). In other words, an alternative is not considered if an attribute does not meet the cut-off constraints indicated by the respondent. When the coefficient of the penalty is a low negative value, respondent n follows a "soft" conjunctive decision-making rule, meaning that respondent *n* sometimes violates his/her own conjunctive rule (Aizaki et al., 2009).

A respondent follows instead a pure disjunctive decision strategy when he/she chooses an alternative having a certain attribute level irrespective of other attributes of the same alternative or of the attributes of the competing ones. Then the coefficient of the penalty associated with the violation of that attribute is a high positive value, while all the other ones will be zero.

4.3.1 The enhanced model

Starting from Swait's (2001) cut-off approach, we augmented it by incorporating cut-off violations as context effects. We extended the consumer's utility associated with an alternative by adding the violations that occur in competing alternatives. Our hypothesis was that respondents can decide to choose an alternative *i* and to violate a stated cut-off for attribute *k* of that alternative depending also on the violations that occur in competing alternatives in the choice card. That is to say for example, if a choice set involves three alternatives (blueberries, raspberries, strawberries), the choice of blueberries by a

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have each attribute above a specific threshold (Gilbride and Allenby, 2004). For example, one might eliminate a product from a choice set because of its price regardless of its features.

Alternatively, a disjunctive rule results in the acceptance of an alternative that has a very high standard on at least one attribute, irrespective of its values on the other attributes (Elrod et al., 2004). For example, one might accept a product grown in Trentino disregarding its price or how it has been produced.

respondent may be influenced not only by how many violations are in blueberries but also on how many violations occur simultaneously in raspberries and strawberries. A respondent may therefore be pushed to choose a product by violations occurring in other products.

As in Swait ‘s model, for each attribute in each alternative, violations that occur in other alternatives are defined as

$\delta_i (\theta_{ik}^{L} - X_{ik}) - \rho_{jk} \leq 0$ and $\delta_i (X_{ik} - \theta_{ik}^{U}) - \varsigma_{jk} \leq 0$.

Then, including the effect of penalties that regard other alternatives presented in the choice card in the deterministic part of the utility function, our model becomes:

$$\text{Max } U_{pi} = \sum_{i \in C} \delta_i U_i (X_{ik}) = \sum_{i \in C} \delta_i (\beta_{ik} X_{ik}) + \sum_{i \in C} \sum_{k} \delta_i (w_{ik}\lambda_{ik} + v_{ik}\gamma_{ik}) + \sum_{j \neq i \in C} \sum_{k} \delta_i (r_{jk}\rho_{jk} + s_{jk}\varsigma_{jk}) + \varepsilon_i \quad (3)$$

$$\text{st. } \sum_{i \in C} \delta_i = 1, \delta i = 0, 1, \sum_{i \in C} \delta_i p_i \leq Y_n,$$

$$\delta_i (\theta_{ik}^{L} - X_{ik}) - \lambda_{ik} \leq 0, \delta_i (X_{ik} - \theta_{ik}^{U}) - \gamma_{ik} \leq 0,, \lambda_{ik} \geq 0, \gamma_{ik} \geq 0, \forall i \in C,$$

$$\delta_i (\theta_{ik}^{L} - X_{ik}) - \rho_{jk} \leq 0, \delta_i (X_{ik} - \theta_{ik}^{U}) - \varsigma_{jk} \leq 0, \rho_{jk} \geq 0, \varsigma_{jk} \geq 0, \forall j \in C.$$

where

- λ_{ik} and γ_{ik} represent the amount by which the cut-offs are violated in choosing alternatives for the lower limits and for the upper limits respectively. Both are ≥ 0.
- w_{ik} and v_{ik} are the marginal disutilities for individual n of violating respectively the lower and the upper stated cut-off value.

- ρ_{jk} and ς_{jk} represent the amount for individual *n* by which the cut-offs are violated in other competing alternatives ($j \neq i$) present in the choice set for the lower limits and for the upper limits respectively. Both are ≥ 0.
- r_{jk} and s_{jk} are the individual marginal utilities/disutilities that impact on alternative *i* for individual n of violating respectively the lower and the upper stated cut-off value in other competing alternatives ($j \neq i$) present in the choice set.

Like Swait (2001), we changed only the specification of the deterministic part to allow the context effect to be incorporated into the penalty function. Moreover, following Swait (2001), we assumed that self reported cut-offs have no measurement error. If, instead, we had assumed that an error occurs in stating thresholds, then an additional error term should have been added, which would require the development of specialized software.

4.4 The Choice Experiment

In this section, we present the method used and the data collected to test the proposed model. The empirical context of interest regards the purchasing behaviour of small fruits obtained employing alternative production methods. We decided to focus on strawberries, blueberries and raspberries because of their market importance and their year long presence on the supermarket shelves (for more information see Chapter 1).

Among the different stated preference techniques to investigate consumer preferences and purchasing behaviour, choice experiments (CE) represent the latest step that has emerged within the field (Adamowicz et al., 1998; Bennett and Blamey, 2001; Holmes & Adamowicz, 2003; Kanninen, 2007). It is well known that it involves constructing multiple scenarios, presenting a choice set and asking respondents to choose the

preferred option among different alternatives described by various attributes and prices (Naidoo and Adamowicz, 2005). Therefore, we designed a labelled choice experiment with three alternatives (strawberries, blueberries and raspberries) and the "non-of-these option".

The survey was developed following the typical five stages of a choice experiment survey: 1) selection of attributes and definition of levels, 2) selection of an experimental design, 3) construction of the choice set, 4) testing and piloting and 5) measurement of preferences via field survey administration. Particular attention is required in designing the CE in order to minimize biases (section 4.4.1.4).

The investigation of threshold as decision heuristics requires the direct elicitation of these thresholds during the survey (Swait, 2001) and therefore a special section of the survey is designed to elicit alternative specific cut-offs (section 4.4.1.5) .

4.4.1 The survey design

4.4.1.1 Identification of alternatives, attributes and levels

The first essential step in the design of a CE is the identification of the relevant attributes and their possible levels that constitute the choice set. In actual fact, as Coast and Horrocks (2007: p.25) highlight: "the rigour with which the first two stages of discrete choice experiments (attribute development and the choice of levels of these attributes) are generally conducted is questionable".

Through a review of the literature (see previous chapter), a list of attributes has been identified to be strongly determinant in consumers' choice to purchase and pay a premium for fresh fruit and vegetables with credence attributes.[12] These are visual and

[12] A "credence good", as reported in the previous chapter, is a product that provides more than simply the privately appropriable quality benefits of eating and nutritional quality. It incorporates a wide range of

smell components, pesticide free, local production, certification, origin, health, and organic. Moreover, given the increasing importance of the climate change issue, we added climate change mitigation practices to this list.

Then, from this extended set of attributes, participants in two focus groups selected 1) production method 2) visual aspect 3) origin 4) presence of climate change mitigation practices as being important for small fruits.

Regarding the number of levels, we followed the suggestions of Hensher (2004, 2006a, 2006c) to use fewer levels and to keep the range of levels as wide as possible. He actually found that a wider attribute range increases attribute processing and decreases the likelihood of misspecified estimates (Kaye-Blake et al., 2009; Jaeger and Rose, 2008).

Levels of non-monetary attributes and their description to the respondents were defined with the help of specialists (Table 4.1). For the production methods, four types were identified: Conventional, Integrated, Innovative and Organic and for each of them the following description was provided to the respondent in the survey instrument. Conventional control refers to a pest management that employs pesticides (chemicals) to reduce pests and disease. Integrated pest management (IPM) is a pest control strategy that integrates chemicals with biological agents (insects, microorganisms and natural enemies), agronomic techniques and cultural methods. In small fruits, it can lead to a reduction in the number of chemical treatments by 13-23% compared to conventional control. “Innovative” integrated pest management is an IPM that enhances (intensifies) the use of biocontrol agents and agronomic techniques as much as possible until a 60-83% reduction in the number of chemical treatments is reached compared to conventional control.

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symbolic, imagined and other less tangible characteristics such health and/or environmental-related aspects that the consumers can hardly detect (Midmore et al., 2005).

Organic production is a farming process that excludes or strictly limits the use of synthetic fertilizers and synthetic pesticides, and that maintains, promotes and enhances biodiversity, biological cycles, and soil productivity http://ec.europa.eu/agriculture/organic/organic-farming/what-organic_en). Looking at the different production methods from the consumer's point of view, while preferences for organic food have been extensively studied, research into consumer response towards IPM or other sustainable production is currently scarce in the literature (Govindasamy and Italia, 1998; Loureiro et al., 2001; Scarpa et al., 2005).

For appearance, three levels were identified: good, mediocre and bad. The term refers to visual quality and regards the shape, the colour, size, skin and presence of mould or damage to the small fruits. For each level, a description was given to the respondents in order to provide the same information to everyone (see Appendix 4.A.).

Three levels were also identified to test the impact of origin: abroad, Italy, and Trentino. Initially, following Darby et al. (2008), we wanted to investigate the geographic extent of locally grown attributes. However, given the moderately-sized area of the Trentino region, adding another level "grown in a local farm" could have proven to be inefficient leading to multicollinearity.

Reduced climate impact refers to the implementation of agricultural practices that aim to decrease greenhouse gas emissions (carbon dioxide and methane) and therefore to reduce the impact of farming on climate. These practices can be applied within each type of farming whether conventional, IPM, innovative or organic. The choice to include this attribute arises from the growing attention recently devoted to the issue of Climate Change and to the increasing interest in studying the effect of agriculture on climate change (Desjardins et al., 2007). Farmers can influence greenhouse gas emissions through decisions regarding their production system (crops and/or livestock systems

and/or alternative productions like energy cropping, biofuels, and biogas), and regarding the choice of variety, level of mechanization, irrigation, fertilization schedules, etc. (Seguin et al., 2007). So, from among the several mitigation practices which can help agriculture to reduce gas emissions (Johnson et al., 2007), some of them can be applied independently of the chosen production method. For this attribute, two levels were identified: the presence or absence of mitigation practices in the farming. Although it might be argued that this attribute may be correlated to a type of production method as integrated or organic ones, this relationship, however, has not been proved to be unambiguous. In fact, Schmid et al. (2007) reported that the likely GHG impact due to IPM and organic agriculture may be positive or negative depending on the crop and the technology employed. Recently, there has been a debate on the impact of organic farming on GHG. Foster et al. (2006) conducted a literature review on studies that employ the tecnicque of environmental Life Cycle Assessment to study the environmental impact of food products. They reported that in general, many organically grown foods have a lower environmental impact than equivalent foods grown conventionally, but that "there is insufficient evidence available to state that organic agriculture overall would have less of an environmental impact than conventional agriculture. In particular, from the data we have identified, organic agriculture poses its own environmental problems in the production of some foods, either in terms of nutrient release to water or in terms of climate change burdens." (Foster et al., 2006: p.14). Also Gattinger (2010) found that although mitigation practice may have a higher potential when combined with organic farming there are still not consolidated data available yet on carbon sequestration and GHG fluxes under organic farming practices.

Price levels were determined from preliminary research in different supermarkets. They reflect the range of market prices registered in local supermarkets and grocery

stores during the year. They were selected to be wide enough to cover the potential mean WTP (Hensher, 2004, 2006a). Six price levels were identified varying from € 2.40 to € 4.15 for 125g box of blueberries and raspberries and from € 0.95 to € 2.95 for 250g box of strawberries (Table 4.1).

Table 4.1. Attributes and levels employed in the CE

Attribute	Level
Method of production	Conventional
	Integrated Pest Management[a] (IPM)
	Innovative[b] (INNOV)
	Organic (ORG)
Appearance	Bad
	Mediocre
	Good
Origin	Abroad
	Italy
	Trentino
Low emission practices	Yes
	No
Prices of Blueberries and Raspberries	2.40, 2.75, 3.10, 3.45, 3.80, 4.15
Prices of Strawberries	0.95, 1.35, 1.75, 2.15, 2.55, 2.95

[a] IPM denotes a reduction in chemical treatments of 13-23 % compared to CON

[b] INNOV denotes a reduction in chemical treatments of 60-83 % compared to CON

As mentioned before, the identification and definition of attributes and levels is the result of both desk research and intensive focus group discussions with the general public and scientists. We tested whether the attributes and levels considered were considered appropriate for the chosen category of products (small fruits), whether the definition of the different attributes were easy to understand. Moreover, sentence length, wording and screen layout of the survey were also analyzed to enhance readability and make the survey more "fluid" and effective.

4.4.1.2 The construction of the experimental design

In designing a survey an important step is to choose the appropriate experimental design that allocates attributes and their levels to different choice sets (Louviere, 1988; Chrzan, 1994, Scarpa and Rose, 2008). In literature, many efforts have been devoted to studying statistically appropriate design (Kayle-Blake et al., 2009) able to isolate the main effects of attributes (Louviere et al., 2000).

There are different design types that a researcher can consider in constructing a CE and that we describe briefly here.

1. A full factorial design. It consists of all possible combinations of levels for all attributes and allows to estimate all main and interaction effects. However, in many cases it become difficult to employ this type of design, since the number of choice sets generated will be too many for any respondent to handle.
2. A fractional factorial design. It consists in selecting a subset of choice situations from the full factorial and uses these in construing the choice survey. Researchers used this to solve the problem of too many choice set per respondent. The best known fractional factorial design type is the orthogonal design. Traditionally, this type of design has been used since it implies zero correlation between attributes, it is generally easy to construct, and as suggested by Rose and Bliemer (2009) since it is a result of historical impetus (the exiting experimental design theory was dealing mainly with linear models where orthogonality criterion is considered important. However, in the last decade, orthogonal design has been questioned and it has been demonstrated its inappropriateness on econometric models typically used to analyse SC data as logit model, opening the path to new method to construct experimental designs (Rose and Bliemer, 2009).

Recently, instead of merely looking at the correlation between the attribute levels, researchers have focused on increasing the statistical efficiency of choice sets (Huber and

Zwerina, 1996; Sandor and Wedel, 2001; Kanninen, 2002; Zwerina et al., 2006; Rose and Bliemer, 2006).

3. Efficient design. This design is a type of fractional factorial design that relaxes the orthogonality requirement and aims to maximize the information from each choice situation, by minimizing the determinant of the asymptotic variance - covariance (AVC) [13] matrix for the design, that is to minimize the standard errors of the parameter estimates, providing therefore more reliable estimates. This design is primarily relevant to studies involving small finite samples since it allows researcher to produce more efficient data (by increasing the accuracy of an estimated parameter by 10-30% (Sandor and Wedel, 2001; Scarpa et al., 2007)) with an equal or lower sample size (Rose and Bliemer, 2009). Several criteria have been proposed to assess the efficiency of different design (Scarpa and Rose, 2008) and those most used are the D-error and the A-error. The D-error criterion means minimizing the determinant of the AVC matrix by assuming a single respondent, $\Omega 1$, and scaling this value by the number of parameters, K: $(\det(\Omega_1)^{1/K})$; while the A-error the trace of the variance-covariance matrix: $(\mathrm{tr}(\Omega_1)/K)$. Therefore, the lower the D- or A- error, the more efficient the design. To calculate D-error, however, the researcher has to hypothesize a set of prior parameters. In fact, contrary to experimental design methods for linear regression, the construction of an efficient experimental design for a probabilistic choice model requires knowledge of the parameter values (Atkinson and Donev 1992; Sandor and Wedel 2001; Yu et al., 2008). Prior parameters are coefficient estimates (β) of attributes that convey some information on the effect that those attributes have on the probability of choosing that product, when all other parameters are

[13] The AVC matrix of discrete choice models is derived by taking the negative inverse of the expected second derivatives of the log-likelihood function of the model (Rose and Bliemer, 2009).

held constant (Jaeger and Rose, 2008). In research, prior values have often been assumed to be zero as if no information were available (Sandor and Wedel, 2001). Nevertheless, recent studies have found that efficiency of choice sets depends also on the utility weights of the attributes (Kanninen, 2002) and therefore assuming these values equal to zero could lead to low efficiency design (Sandor and Wedel, 2001, p.430). Prior estimates of betas can be obtained from the literature, pilot studies, focus groups and expert judgment (Rose and Bliemer, 2009) and can then be used to compute D-error (Jaeger et al., 2008). In fact, priors are known by approximation (Rose, 2009)11. If researchers did indeed know priors with a 100 percent certainty, they would not perform any survey. According to Bayesian analysis14, the researcher assumes thus that prior parameters are not fixed but random, that is they are "represented by a probability distribution over a range of values that the parameters can take, where the probability represents how likely the researcher thinks it is for the parameters to take a particular value"(Train, 2003: Ch. 12 p.284). Assuming for example that prior parameters are distributed as a normal distribution $\beta k \sim N(\mu k, \sigma_k^2)$ and using D-efficiency as criterion, then Bayesian efficiency (that measures the expected efficiency) is computed by calculating the average of the simulated D-errors

$$\text{Bayesian D-error} \approx \frac{1}{R}\sum_{r=1}^{R} \det(\Omega(\beta^{(r)}|X))^{1/K},$$

where $\beta(r)$ are random draws from the distribution function (r = 1,…,R draws).

[14] For readers who may be less familiar with Bayesian methods, see Chaloner and Verdinelli 1995 for a review of Bayesian experimental designs,

4.4.1.2.1 Generating the experimental design

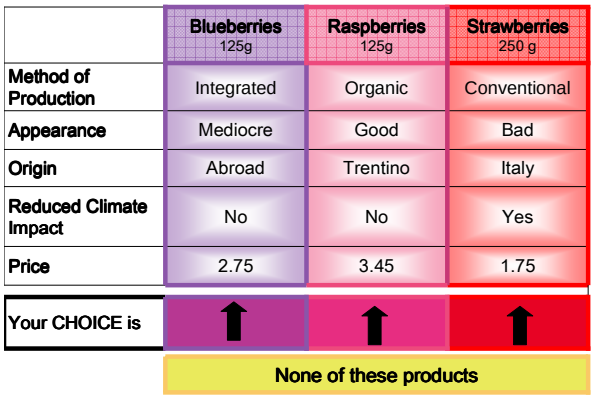
In the present study, we used a Bayesian D-efficient design since it allows to produce more reliable parameter estimates with smaller sample sizes than other forms of designs (Rose and Bliemer, 2009; 2011), and as it is state-of-the-art with respect to the design of labelled SC experiments (Jaeger and Rose, 2008).

Since alternatives were labelled, the full factorial structure was equal to L^{MA}, where L is the number of attribute levels, A the number of total attributes and M the number of alternatives (Louviere et al., 2000). In this study, applying this equation reveals that a total of $\_4^{(3\times1)} \times 3^{(3\times2)} \times 2^{(3\times1)} \times 6^{(3\times1)}$ = 80,621,568 choice sets are possible. Due to this large amount of choice sets, we initially employed a computer generated orthogonal fractional factorial design that generated 36 choice sets. Since asking the respondent to evaluate 36 choice sets is totally unreasonable, we divided the design into four equal blocks of 9 choice sets each. Nine choice tasks seem to be reasonable according to the empirical evidence of previous studies about learning and fatigue effects (see in detail below, section 4.4.1.4.2) (Caussade et al., 2005).

The survey was administered to an initial sample of 120 respondents (preliminary survey). Each respondent faced nine choice tasks and produced 9 choices as a result. The estimates of betas obtained from a multinomial logit (MNL) model were employed to create a Bayesian D-efficient block design. The final design was generated using Ngene software and created 36 choice sets divided into 4 blocks of 9 choice sets each. The design was attribute level balanced (see Appendix 4.B.)

4.4.1.3 The construction of choice sets

Each of the 9 choice cards presented 3 labelled alternatives and the "none-of-these" option (Figure 4.1). This option was also added to meet the property of exhaustiveness (Train, 2003, p:15)[15], and to give more realism to the questionnaire and to forecast how category shares would vary as products become more or less attractive (Johnson and Orme, 1996). The "none of these" option is the base from which other alternatives are compared (Louviere, 1988).



	Blueberries 125g	Raspberries 125g	Strawberries 250 g
Method of Production	Integrated	Organic	Conventional
Appearance	Mediocre	Good	Bad
Origin	Abroad	Trentino	Italy
Reduced Climate Impact	No	No	Yes
Price	2.75	3.45	1.75
Your CHOICE is	⬆	⬆	⬆
	None of these products		

Figure 4.1. Example of a choice card

To avoid attribute-order effects (see next section), a mechanism that automatically randomizes rows and columns of the choice cards was employed. This was also done for price, even though it may fit more logically at the beginning or end of a profile than somewhere in between (Chrzan, 1994).

[15] According to Train (2003, p:15): "…the set of alternatives, called the *choice set*, needs to exhibit three characteristics: 1) the alternatives must be *mutually exclusive* from the decision maker's perspective; 2) the choice set must be *exhaustive*, in that all possible alternatives are included; and 3) the number of alternatives must be finite."

Before showing the nine choice cards to respondents, the following "cheap talk" script (Figure 4.2) was provided to respondents in order to reduce hypothetical bias (for detail see next section).

The Choice

Now the most useful part of the research begins. You will have to make 9 sequential choices among three products that vary by origin, method of production, appearance, attention devoted to climate change and price.

Previous studies have demonstrated that people often respond to surveys differently to how they behave in the real purchase situation. Usually, it is especially common for one to state a higher willingness to pay than what one actually is willing to pay for the goods in the store, leading to unusable results. This happens because it is easy to be generous when one does not have to pay more in the store or because one generally has the tendency to choose an answer which is viewed as more socially acceptable than the other ones or that is perceived as having good answers to the interviewer.

Therefore, we ask you to carefully consider the cost of the products presented and to choose your preferable product thinking only of your personal preferences.

Figure 4.2. The cheap talk script

Moreover, a reminder text was shown to the respondent to encourage him or her, in the choice of product to behave as he/she does everyday and not occasionally or on special occasions (Figure 4.3). Connor et al. (2001) examined how people manage values in making food choices in various contexts and found that people change their values according to the eating occasion they face. According to their analysis, what day of the week it is or specific circumstances can induce people to relax their major food values, affecting therefore their food choice decision. Moreover, specific to small fruits, Moser and Pertot (2005) found that national holidays, religious and lay days on average can have a major effect on price. In the Easter week the price increased by about 30%, while during the Christmas period prices increases by 70%.

Now, imagine yourself to be in the following situation:

Today is a normal day (you are not on holiday and there is no special occasion), you feel good and you have buying small fruits in mind.

Which product would you choose to purchase among those presented, if today these products were the only ones available?

Figure 4.3. The remainder text used in the CE

4.4.1.4 Mitigating biases

Although choice experiment technique may suffer less severe sources of bias than those found in other stated preferences techniques as contingent valuation (Hanley et al. 1998), it is still a good idea to control and mitigate them as much as possible. In this section we describe what has been employed in this study to reduce the different kinds of bias that can influence or undermine the results of the research.

4.4.1.4.1 Hypothetical bias

In stated preference literature, particular attention has been devoted to the difference between hypothetical and real values since it leads more often than not to an overestimation of the WTP estimates (for a review and meta studies see List and Gallet, 2001; Little and Berrens, 2003; Murphy et al., 2005a; and Harrison, 2006). Its existence has been investigated mainly by comparing hypothetical to actual (real) willingness to pay and the aforementioned reviews suggest that WTP values are higher when hypothetical setting is employed. The literature that compares actual and hypothetical payments in CE is still rather restricted. Respondents generally report higher hypothetical than real WTP,

even if Carlsson and Martinsson (2001) founded statistically equal hypothetical and non hypothetical CE responses.

To reduce the hypothetical bias, the cheap talk approach was developed by Cummings and Taylor (1999). It consists of a long script - that respondents have to read before choosing - that explicitly tells respondents what is hypothetical bias and why it occurs. It focuses the respondent's attention to the consequences of the choices as if these were real or with real effects. Its aim is to reduce or eliminate the overestimation of the willingness to pay stated by respondents in a hypothetical setting, just making respondents aware of it.

Results associated with its use have been found to be mixed. Several studies (Cummings and Taylor, 1999; List and Sihna, 2004; Bulte et al., 2005; Carlsson et al., 2005; Murphy et al., 2005b; List et al., 2006; Chowdhury et al., 2009) proved the potential success of using cheap talk script and found a lower marginal WTP in the cheap talk version survey. Other studies found that it had no effect (List, 2001; Poe et al., 2002; Brummet et al., 2007) or increased the bias depending on its length (mainly when short) structure, and payment amount (Aadland and Caplan, 2003, 2004). Overall, as stated by Harrison (2006) and Ladenburg and Olsen (2007: p.3), cheap talk seems to reduce the hypothetical bias in stated preferences studies, even if, in its present state, it might not yet be a hypothetical bias panacea and work in all contexts.

In our survey, we made use of this tool (Figure 4.2) even if we did not test for it and the cheap talk was provided to respondents before showing the nine choice cards.

4.4.1.4.2 Controlling for other biases: Ordering, Learning and Fatigue effects

Other than these specific methodological issues related to the hypothetical bias, we considered some other different kind of biases that can influence or undermine the re-

sults of a CE study. One of these biases is the order effect. According to Chrzan (1994: p.166), there are three types of ordering effect: (1) choice set order (the sequence of cards), (2) order of alternatives within choice sets and (3) attribute order within alternatives. Order effect refers to the sequence of choice cards and it resembles learning effect (see below), right-to-left and top-to-bottom biases referred to the position in which alternatives and attributes appear in the choice card, respectively. Showing cards always in the same order, with the alternatives and attributes at the same place in the card might introduce bias in the estimates and may impact on overall model parameter (Kjaer et al., 2006; Dobel et al., 2007; Glenk, 2007).

We also considered the issue of learning effect and fatigue effect. Learning effect refers to the dynamic learning process that occurs when the respondent makes consecutive or repeated choices. As he/she progresses through the survey, he/she learns his/her preferences and how to express them more quickly and reliably (Allenby et al., 2005; Darby et al., 2008; Kaye-Blake et al., 2009). Johnson and Orme (1996, p.22) analyzed 21 data sets where the number of choice cards ranged from 8 to 20 and they found that average response times ranged from approx. 35 seconds for the first task to 12 seconds for the last. Moreover, evidence shows that there is an increase in efficiency, a decrease in error variance and a change of focus as the respondent moves through successive choice cards (Johnson and Orme, 1996; Allenby et al., 2005; Caussade et al., 2005). Nevertheless, increasing the number of choice cards to present may induce fatigue or boredom (Savage and Waldman, 2008), reducing the quality of the data. However, it has been found that the gain derived from the learning effect outweighs loss from fatigue and boredom (Johnson and Orme, 1996: p.7). Moreover, previous results (Caussade et al., 2005; Bateman et al., 2008; Scarpa et al., 2009b) suggest that the order in the sequence should have a gradually higher effect on scale, reaching a peak and then declining when “fatigue ef-

fects" kick in, over-riding the learning effect. More specifically, Caussade et al. (2005) found that error variance decreases moving from one up to nine choice cards and Scarpa et al. (2009b) indicated that the scale increases gradually from the first to the 11th rank-order task, and then declines quite rapidly for ranking tasks 14-16. These results convinced us to present nine choice cards to respondents.

Moreover, in order to avoid pro-social behaviour, we performed the experiment in a natural setting (store) and not in a laboratory. Evidence has shown that this behaviour disappears when subjects are in a natural occurring market place (List, 2006).

4.4.1.5 Cut-off elicitation and ranking

In previous studies, cut-off elicitation has been made by asking respondents directly to state their minimum or maximum threshold for a particular attribute as an open-ended question - for price, to state the maximum additional amount they are willing to pay over the current price - (Swait, 2001; Marcucci and Gatta, 2009; Bush et al., 2009); or to choose from among different cut-off options, selecting the one closest to their preferences (Aizaki et al., 2009; Ding et al., 2010). In our study, for each small fruit respondents were asked to select, from among several cut-off options, the level of method of production, origin, and appearance they consider to be the minimum requirement for purchasing it. For the price, they were asked to choose the maximum level they were willing to pay. To facilitate the understanding of this task, the respondent was provided with an example. After this, respondents were asked to rank the five attributes in order of importance they have in influencing their purchase decision. We asked respondents to rank before and after the CE in order to investigate the choice consistency of the respondent. It is reasonable to assume that respondents form their relative importance tradeoffs not only at the beginning of the choice experiment process but throughout the entire survey. If exists

one common underlying perception during both the attribute importance ranking and the choice-making processes, both should carry at least some marks from the same line of perception (Hu, 2008).

According to both Swait (2001) and Hu (2008) importance rating and cut-off reporting should be collected before the choice task so they are free of contextual experience and are based on consumers' past experience and not on information provided in the choice experiment (attribute levels) itself. Nevertheless this data, coming from the 'top-of-mind' as Swait (2008) put it, might be spurious. On the other hand, post choice cut-offs might lead to poor predictive estimates. However, Bush et al. (2008) compared results obtained by asking respondents to state their cut-offs both before and after the CE and they found no significant difference. Furthermore, a likelihood ratio test of the null hypothesis that the estimated preference parameters are independent of the positioning of the cut-offs question (before of after the choice tasks) fails to reject this null.

4.4.1.6 The questionnaire structure

The questionnaire consists of six parts.

The first involves consumption and attitudinal questions ("warm up" questions) and it aims to collect data on the respondents' small fruit shopping habits (for whom, in which period of the year, how often and where). Respondents were also asked if they acquire or ask information about the origin and the method of production of fresh fruit and if they purchase local products. To elicit which factors lead the respondent to buy local products, respondents were asked to provide an opinion on several factors through a five-point semantic scale (from unimportant to important). The second defines the concepts used in the survey. It aims to provide the same information to each respondent about different levels of methods of production (from conventional to organic), of fruit appear-

ance (visual quality), and about low emission production. Moreover, it helps the respondent to familiarize with the attributes and their levels. The third aims to identify alternative specific cut-off values and first ranking (for details see the section above). To elicit rank, the respondent will touch the five attributes, the first touched is the most important, the second touched the second and so on. The fourth part contains the choice task, with 9 choice cards per respondent (for details see the section 4.4.1.3).

The fifth part aims to collect the second ranking to test uncertainty in the decision process (for details see the section 4.4.1.5), while the last part aims to elicit the usual basic socioeconomic and demographic characteristics of the respondents such as gender, age, where they live, household composition, nationality, marital status, education, profession, monthly household net income, affiliation to environmental associations and practice of agricultural activities.

4.4.1.6.1 Pre-test survey, sampling and administration

To collect data, we decide to use a touch-screen computer-assisted self-interviewing system, or touch screen CASI, which is a laptop personal computer equipped with a touch-sensitive video monitor and a specific touch-screen pen. This recently developed method has many benefits compared to the traditional paper-and-pencil method. It allows the researcher to standardize question administration (Metzger et al., 2000), to generate a large sample size quickly reducing the interviewing time (Brown et al., 2008), to reduce the respondent's predilection to modify or change answers (Cooley et al., 2001), to reduce time devoted to data entry and to obtain clean data files (Metzger et al., 2000). Nevertheless, this method has been found to attract more likely respondents who are more familiar with computers, (Sainsbury et al., 1993; Couper and Rowe, 1996; Brown et al., 2008) introducing therefore potential bias to the survey (Sainsbury et al.,

1993). During the pre-test survey (120 interviews) carried out in June 2009, respondents generally did not highlight any problems, but instead they showed interest towards this new technology.

Purpose-built software was developed with the Borland Delphi language to administer the survey. It generates the screens and registers all responses in a text file. It records the beginning and end time of each screen and data according to pre-defined codes. Responses were entered by pressing with the pen or a finger on the box containing the appropriate answer on the screen. Once the respondent touched the preferred box on the screen, automatically the next question or screen appeared and so on. To complete and finish the survey, respondents had to answer all the questions presented. An option to stop the interview was also added following Cooley et al. (2001). Moreover, the software allowed us to randomize the columns and rows of the choice card and to keep track of respondent time taken on each question. A mechanism was also devised to ensure that the four blocks of nine choice situations that comprised the design were presented the same number of times (n = 70).

Data for the final survey was collected during July and August 2009 by three trained interviewers in three different areas of Trentino (Mezzolombardo, Trento and Pergine) and in different types of food store: 5 supermarkets, 2 cooperative supermarkets and 3 grocery stores. To capture all types of grocery shoppers, interviews were conducted from weekdays to weekends and from morning to evenings. Respondents were intercepted at the entrance of each supermarket, using a systematic sampling probabilistic design by drawing randomly at an approximate rate of one out of 5. After having explained the aim of the research, interviewers asked their availability to participate in the survey. Eligibility to participate required a respondent to answer affirmatively to two screening questions: i) being a primary food shopper in the household (make at least 50%

of food purchases) and ii) eating and buying small fruits such as blueberries, raspberries, strawberries. Once participants had passed the screening questions, they started the survey.

Out of the 516 people approached, 37% declined to be interviewed immediately, and another 7% declined after they had listened to the introduction, before the screening questions. In addition, five participants did not complete the survey, so we excluded their responses. The final sample usable for estimation resulted in 280 completed questionnaires. Each respondent answered nine choice questions, each consisting of a four-way choice: three small fruits and a none-of-these option. Each participant completed the survey alone at his/her own pace by personally pressing with the pen or a finger on the box containing the preferred answer on the screen (however, an interviewer was always present to guide him/her as needed). At the end of the survey the respondent received a small gift. Participants were guaranteed anonymity and that data would be analyzed in aggregate form, so that any individual person could not be identified.

A summary of sample characteristics is provided in Table 4.2. The average age of the respondents was 47. Most of them were female (84%), married or living with someone (74%), and did not live in city centers or surrounding areas (54%). More than half of the participants had a secondary school diploma (60%), and were working at the time of the survey (65%). The average household net income was between 2,000 and 3,000 euro/month and the household food expenditure was 103 euro/week on average. It is interesting to note that about forty per cent of the sample practiced agricultural activities (this data does not refer to domestic gardening) and more than half considered themselves an environmentalist (62%).

Table 4.2. Summary of sample characteristics (n = 280)

Characteristics	Mean	St. dev	Absolute freq.	Percent %
Age (years)	47	(12.04)		
20-30				8.57
30-40				25
40-50				33.21
50-65				26.07
>65				7.14
Female (%) [a]				83.9
Italian citizen [a]				97.50
Status				
Single				13.93
Married				73.93
Separated\divorced				6.43
Widowed				5.71
HH members[b]				
children <14	0.50 [b]	(0.81)		
with people15-19	0.24 [b]	(0.24)		
with people 20-64	1.24 [b]	(1.24)		
with people >64	0.20 [b]	(0.20)		
HH food expenditure (Euro/week)	103.2	(51.5)		
Practice of agricultural activities				36.43
Consider himself an environmentalist				62.14
Belong to an environmental association				11.07
Education				
Elementary school [a]				3.57
Middle school [a]				20.71
3 year diploma [a]				15.71
High school diploma [a]				35.34
College/university degree [a]				24.64
Post university education [a]				0.0
Occupation				
Entrepreneur\ self-employed				9.29
Executive				4.29
Office worker\Teacher				44.29
Worker				6.07
Housewife				20.00
Currently unemployed				0.71
Fixed-term\project contract				0.71
Student				2.86
Pensioner				11.79
HH net income (Euro/ month)[a]				
<1000				3.93
1000-2000				29.64
2000-3000				36.07
3000-4000				12.86
>4000				6.43
I don’t know				2.50
Prefer not to answer				8.57
Respondents living in [a] :				
City centers				18.21
Suburban/surrounding areas				23.93
Villages\small villages				53.93
Isolated areas				3.93
Number of respondents	280			

[a] percentage of sample possessing the specific characteristic
[b] range values between zero and six

4.4.2 Model and Hypotheses

In section 4.3 we outlined a utility model which incorporates the context effect, seen as the violation of competing alternatives, in a non-compensatory model (see 4.3.1 The enhanced model). Applying this model to consumer choice of small fruits, and assuming as a base reference the utility derived from the none-of-these option, the utility functions of small fruits are described below. The experiment we conducted being labelled, these utility functions include alternative specific variables for method of production, appearance and origin. This specification allowed us to determine whether the sample had different and/or particular preferences for the three small fruits and to provide more valuable information to marketing managers, growers' associations and policy makers. Regarding climate change and cost, they were assumed a priori to be generic to the three types of small fruits. In fact, we assumed that a respondent who is price sensitive and/or environmentally friendly, would be so independently of the product presented.

So, the utility functions of small fruits takes the following form[16]:

$$U_i = ASC_i + \left[\sum \beta_{ki} X_{ki} + \sum \beta_k X_{ki}\right] + \left[\sum w_{ki} V_{ki} + \sum v_{\Pr i} \Pr ice_i\right] + \left[\sum r_k V_{kj} + \sum s_{\Pr} \Pr ice_j\right] + \varepsilon_i,$$

where

- ASC_i are the alternative specific constants referring to the type of small fruit;
- $\sum \beta_{ki} X_{ki}$ includes alternative specific attributes (method of production, appearance and origin) and $\sum \beta_k X_{ki}$ includes generic attributes (low greenhouses gas emissions and price);

[16] For a description of utility function employed in the different models, see Appendix 4.C.

- $\sum w_{ki} V_{ki}$ includes alternative specific violations in alternative *i* referring to attributes with a stated lower threshold limits (method of production, appearance and origin) and $\sum v_{\Pr i} \Pr ice_i$ includes the alternative specific violation for the stated upper limit for price*;*
- $\sum r_k V_{kj}$ includes alternative specific violations that occur in competing alternatives $j, \ \forall j \neq i$ for method of production, appearance and origin while $\sum s_{\Pr} \Pr ice_j$ refers to violation of stated upper limit for price that occur in competing alternatives $j, \ \forall j \neq i$.

An individual will evaluate each alternative and then he will choose alternative *i* among a complete choice set C, if and only if $U_i > U_j$ for $\forall$ j ≠ i. The probability that alternative *i* is chosen can be written as

$P_i = P(i|C) = P\ (V_i + \varepsilon_i > V_j + \varepsilon_j)$ for $\forall$ j ≠ i.

Under the assumption that the error terms of the utility function are independently and identically distributed (IID) following a Gumbel distribution (Extreme Value Type 1), the probability of choosing *i* is given by:

$$P(i|C) = \frac{\exp^{Vi}}{\sum_{j \in C} \exp^{Vj}} .$$

In other words, the probability of an individual choosing alternative *i* out of a choice set of several alternatives is equal to the ratio of the exponential of the observed utility index for alternative *i* to the sum of the exponential of the observed utility indices for all alternatives, including the *i*th alternative (Hensher et al., 2005a, 86).

4.4.2.1 Expected sign of the parameters

Given the qualitative nature of our non-monetary attributes, we employed effect coding to codify attribute levels. Effect coding has been preferred to dummy coding

within discrete-choice analysis, since the coefficients will not be correlated with the constants and there will be no confounding effects (Bech and Gyrd-Hansen, 2005).

The reference level for the method of production is "conventional", for appearance "bad" and for origin "abroad". Then the estimated parameters of the other *l*-1 levels represent the utility, or disutility, that consumer would have if he chose a small fruit with a different attribute level. Looking for examples at the origin, the coefficients for Italian or Trentino origin, assess how much consumers value the production of a small fruit coming from Italy or from Trentino compared to those coming from abroad.

Before performing our model, we hypothesized the relationship between the explanatory variables and the probability of choosing a specific product, taking into account economic theory and results of previous studies. The coefficients of the variables "method of production" and "origin" could take either signs, indicating that respondents might or might not like these attribute levels. In practice, however, we expected positive coefficients for all three levels of method of production (IPM, INN and ORG) (lower use of chemicals, higher the probability to choose that product), and for the two dummy variables of origin (Italy and Trentino) (the closer the production location, the higher the probability of choosing that product). Regarding "Price" and "Appearance", based on general economic theory, we expected a negative coefficient for price, meaning that the higher the price, the lower the probability of choosing that product, while a positive coefficient is instead expected for visual appearance, meaning that the higher the visual quality, the higher the probability of choosing that product. Regarding the sign of climate change mitigation practices, we hypothesized it to be positive. A recent market research survey on 300 Italian consumers (Det Norske Veritas -DNV, 2009), revealed that 83% of interviewees consider it important (quite or very important) to buy food products with low CO_2 emission, even if terms such as "carbon free" or "carbon neutral" were un-

known to 94% of the interviewees. At European level, the recent Special Eurobarometer survey (TNS Opinion & Social, 2010) suggests that Europeans are ready to pay their share to contribute towards emission reduction. About six out of ten respondents (58%) responded affirmatively about their willingness to pay 10% more for agricultural products if they are produced in a way that does not increase climate change. These responses skew more to 'tend to agree' (37%) rather than 'totally agree' (21%), and this skewness is even stronger for Italy where 40% of interviewees 'tend to agree' and 19% 'totally agree'. Among the three products (blueberries, raspberries, and strawberries), we assign a higher probability of being selected to strawberries, being one of the most popular fruits that are consumed when fresh (Garcia-Limones et al., 2008).

Regarding cut-off violations, we expected them to have a positive impact on the utility of an alternative *i* when referring to violations that occur in competing alternatives; while they would have a negative impact on the utility of an alternative *i* when they refer to it.

4.5 Results

In this section we present the results of the choice experiment.

4.5.1 Qualitative analysis

4.5.1.1 Stated cut-off by the sample

Results indicate that when buying small fruits most people have specific requirements in mind and usually for more than one category (Table 4.3). Almost all respondents stated a cut-off for origin and appearance (93.8% and 91.1% respectively), and then for production method (71.7%), while 63% stated a price value over which he/she would not buy any small fruits. Local origin (Trentino) and Good appearance were the most

frequently stated thresholds by respondents while similar shares, between 20-30% of the sample, were observed for the different types of production. As regards the price, 20% of people stated the lowest value and, as expected, this share decreased as the price increased.

Table 4.3. Respondents stating minimum requirements for attribute levels by cultivar and as percentage of total respondents (N=280)

Level		Blueb.	Raspb.	Strawb.	Average	% rep
Method of production						**71.7**
Does not matter		83 (29.6)	78 (27.9)	77 (27.5)	79	**28.3**
Integrated		54 (19.3)	56 (20.0)	54 (19.3)	55	**19.5**
Innovative		61 (21.8)	59 (21.0)	59 (21.1)	60	**21.3**
Organic		82 (29.3)	87 (31.1)	90 (32.1)	86	**30.8**
Origin (93.8)						**93.8**
Does not matter		16 (5.7)	17 (6.0)	19 (6.8)	17	**6.2**
Italy		115 (41.1)	99 (35.4)	126 (45.0)	113	**40.5**
Trentino		149 (53.3)	164 (58.6)	135 (48.2)	150	**53.3**
Appearance						**91.1**
Does not matter		27 (9.6)	25 (8.9)	23 (8.2)	25	**8.9**
Mediocre		61 (21.8)	61 (21.8)	61 (21.8)	61	**21.8**
Good		192 (68.6)	194 (69.3)	196 (70.0)	194	**69.3**
Price						**65.5**
Does not matter		99 (35.4)	99 (35.4)	92 (32.9)	97	**34.5**
Blueb./Raspb	Strawb					
2.40	0.95	79 (28.2)	80 (4.6)	13 (28.6)	57	**20.5**
2.75	1.35	48 (17.1)	47 (11.8)	33 (16.8)	43	**15.2**
3.10	1.75	32 (11.4)	33 (18.2)	51 (11.8)	39	**13.8**
3.45	2.15	14 (5.00)	14 (13.9)	39 (5.00)	22	**8.0**
3.80	2.55	5 (1.8)	3 (13.6)	38 (1.0)	15	**5.5**
4.15	2.95	3 (1.1)	4 (5.0)	14 (1.4	7	**2.5**

4.5.1.2 Occurrence of violations

Comparing the actual choices made by the respondents in the CE with their individually-stated cut-offs, we found that the majority of respondents violated them at least once in the nine choices (Table 4.4) Only nine respondents out of 280 were strictly coherent and did not violate their stated minimum requirements in all nine choice cards. More specifically, out of the 9 choices, the majority (76.8%) violated their stated thresholds for appearance, especially when stating “good appearance”; while 57-66%, violated

them for origin (especially for Trentino), method of production (when stating innovative or integrated), and price. It is interesting to note that only 33% of respondents violated organic production, suggesting that the absence of this requirement may be hardly compensated by other attributes.

However, looking at the observed choices of respondents who violated the stated cut-off, out of a total of 2439[17] choices 3028 violations occurred (Table 4.5). This indicates that on average 1.24 violations occurred for each choice. The greatest number of violations occurred for the method of production (34.6%), in particular innovative production (14.2%), followed by the appearance (29.9%), and the origin (18.2). The lowest numbers were instead for the price (16.6%). Among different small fruits, 45% of violations that occurred regard strawberries, while similar shares (28% and 26%) occurred for blueberries and raspberries respectively.

Table 4.4. Occurrence of violation cut-offs out of 280 respondents

	N° of respondents stating minimum requirements (n=280)	**# respondents violating their stated cutoff** [a]
Method of production	**201**	**171 (61.1%))**
Integrated		118
Innovative		136
Organic		93
Origin	**263**	**185 (66.1%)**
Italy		107
Trentino		140
Appearance	**255**	**215(76.8%)**
Mediocre		149
Good		177
Price	**183**	**160 (57.1%)**

[a] participants could violate more than one category

[17] Out of 2520 choices, we removed the choices made by respondents who never violated the stated cutoff (9people).

Table 4.5. Occurrence of violation cut-offs specified for alternative out of all 2520 choices

Level	Blueberries	Raspberries	Strawberries	Total
Method of production				
Integrated	70	51	115	236
Innovative	128	111	192	431
Organic	103	99	180	382
Origin				
Italy	45	53	91	189
Trentino	134	99	150	383
Appearance				
Mediocre	59	83	154	296
Good	163	145	300	608
Price	146	162	195	503
Total	848	803	1377	3028

4.5.1.3 Ranking information

Regarding the order of attribute importance (Table 4.6), the pairwise comparison between the frequencies of attribute positions in ranking elicited before and after the choice task indicates that there is no statistical difference in the two rankings (for each comparison, χ^2 statistic: > 1.35;df = 4; p-value:>0.05). This indicates that respondents were consistent in their ranking. Origin and appearance are the attributes ranked as most important by the majority of respondents, followed by method of production and price. Climate change mitigation practices are instead generally ranked last.

Table 4.6. Attribute position in both rankings before choices and after choices

Attributes	**1st rank positions**					**2nd rank positions**				
	1st	2nd	3rd	4th	5th	1st	2nd	3rd	4th	5th
Appearance	32.5	20.0	17.5	19.3	10.7	28.2	23.6	23.6	14.6	10.0
Price	12.9	17.9	22.5	21.1	25.7	14.3	18.2	21.4	23.6	22.5
Origin	36.4	30.7	23.2	7.5	2.1	41.4	28.2	22.1	8.2	0.0
Production	15.7	27.5	20.0	32.9	3.9	15.0	26.8	18.6	36.8	2.9
Climate change	2.5	3.9	16.8	19.3	57.5	1.1	3.2	14.3	16.8	64.6
Tot respondents	100	100	100	100	100	100	100	100	100	100

4.5.2 Model estimation

This section summarises the results of CE data analysis conducted to achieve the aim of this paper: demonstrating that the choice of an alternative is influenced by contextual violation in other competing alternatives. Given the high number of parameters involved (74 in the full model), we analysed the data applying a multinomial logit model (MNL) and all models were estimated using Limdep Nlogit (version 4.0) (Econometric Software Inc., www.limdep.com). Table 4.7 provides an overview of the variables employed.

Table 4.7. Regression variable definitions [a]

Variable	Definition	Variable	Definition
Method of production (versus coinventional)			
Pipm	Production with an IPM	VPint	Violation associated with Pint
Pinn	Production with an IPM +BCAs management	VPinn	Violation associated with Pinn
Porg	Organic production	VPorg	Violation associated with Porg
Appearance (versus bad)			
Qm	Mediocre appearance	VQm	Violation associated with Qm
Qh	Good appearance	VQh	Violation associated with Qh
Origin (versus abroad)			
Oit	Italian origin	VOit	Violation associated with Oit
Otn	Trentino origin	VOtn	Violation associated with Otn
Low GHG (versus current emissions)			
CC	Reduced climate impact		
Price	Price	VCost	Violation associated with cos
Alternative specific constants (versus no-purchase)			
ASCBlue	Constant for Blueberries		
ASCRasp	Constant for Raspberries		
ASCStraw	Constant for Strawberries		

[a] In all models, the suffixes –Blue, -Rasp and -Straw refer to Blueberries Raspberries and Strawberries respectively

Table 4.8. summarises the specifications of the four models estimated in this study. The first model is a simple MNL model that specifies the utility function without taking into account any information regarding the stated threshold by respondents. The second model implements Swait's model. That is, it incorporates the respondent's stated cut-offs and assumes a non compensatory utility model. In Model 3 we specified each attribute specific violation in competing alternatives in relation to the alternative under observation, while in Model 4 we estimated the generic effect of violation in competing alternatives.

Table 4.8. Overview of Estimated Models

# model	Model Type	Cut-off penalties	Context effect	Model Description
1	MNL	-	-	Model without penalties (without taking into account any cut-off information)
2	MNL	Yes		Model with alternative specific penalties (taking into account cut-off information): Swait model
3	MNL	Yes	Yes	Model with alternative specific penalties and cumulative context effect

Table 4.9 reports the parameter estimates of the different MNL models. For all models, in addition to the log-likelihood, we reported two measures of model fit, namely the first Akaike Information Criterion (I Crit.AIC) and the first Bayesian Information Criterion (I Crit. BIC)[18]. For the comparison between models we calculated the Likeli-

[18] When estimating model parameters using maximum likelihood estimation, it is possible to increase the likelihood by adding parameters, which may result in overfitting. The AIC and BIC statistics resolve this problem by introducing a penalty term for the number of parameters in the model and thus arriving at a less biased assessment of the ability of a model to predict the outcome. When comparing models on the basis of the AIC and BIC, a lower value indicates a more desirable model. In BIC, the penalty for additional parameters is stronger than that of the AIC.

hood ratio test, $-2\left(LL_{largest\,model} - LL_{smallest\,model}\right)$ distributed χ^2 with K degrees of freedom, where K is equal to the difference between the number of parameters estimated between the two models (Hensher et al., 2005, p:336).

In the next sections we first look at the results for the base models both without (model 1) and with cut-offs (model 2). Then we describe in more detail the results for the main model, developed in this study using the utility specification given in Eq.(3).

4.5.2.1 The no cut-off model

This model represents the base against which we compared the other proposed models (LL= -2848.66, AIC = 2.281, BIC=2.342, $n_{\text{parameters}}$= 26, $n_{\text{observations}}$= 2520). Results show that most estimated coefficients of the variables meet our expectation as regards the sign of the coefficient, except for integrated and innovative production for strawberries and mediocre appearance for raspberries which proved to be negative.

In general, the coefficient estimates of organic production, mediocre and high visual quality, Italian and Trentino origin, and reduced climate impact strategies were significantly positive, implying higher probability of purchase, while the price coefficient was statistically negative, as expected from standard economic theory. Mediocre appearance was found to be significantly positive for blueberries and strawberries and negative for raspberries. Italian origin was found important for blueberries and strawberries, but not for raspberries. Integrated and innovative productions were also found to be not statistically significant, suggesting that consumers may really not perceive the difference compared to conventional production. More specifically, among the variables describing the choice of buying small fruits, Trentino origin and good appearance show the strong-

est impact in all three products, while price was shown to be in 3rd or 4th place in influencing the probability of purchasing small fruits. These were followed by, in order of importance, organic production, mediocre appearance, Italian origin and reduced climate change for blueberries and raspberries; while price, Italian origin, organic production and mediocre appearance resulted for strawberries. The coefficient estimates of ASCs – that indicate the mean effect of all "unobserved" factors or unobserved utility for each option in relation to the "none of these" option – are positive and significant for all alternatives, with the highest probability for strawberries, fulfilling our expectations and confirming the fact that strawberries are one of the most popular freshly consumed fruits (Garcia-Limones et al., 2008).

This indicates that the respondent prefers to buy a product rather than nothing and that among small fruits strawberries have a higher probability of being purchased.

4.5.2.2 The Swait's model

The second model is an MNL model that implements Swait's model incorporating the respondents' alternative specific stated cut-offs and assuming a non compensatory utility model. Incorporating cut-off information into the utility function improves the overall model fit (from LL= -2848.66 to LL = -2775.36, from AIC = 2.281 to AIC = 2.242, from BIC = 2.342 to BIC = 2.358). The Likelihood ratio test reveals that we can strongly reject the null hypothesis that cut-offs play no role in the choices (that is to say all penalty parameters are simultaneously zero) (χ^2 statistic =146.60, df=24, p-value: <0.001).

In general, for all three products, good appearance, organic production, climate change and price were found significant as in Model 1 maintaining the same importance on the probability of purchase, even if their mean values are lower in magnitude; while

mediocre appearance became insignificant. Trentino origin still was of great importance in influencing the decision to purchase, but only for blueberries and raspberries. Interestingly, regarding strawberries, the attribute "origin" changed its role completely. Italian origin became significantly negative (β = -0.360), while Trentino origin do not exert anymore any effect on the probability of purchasing. Integrated production was also found to decrease the probability of purchasing strawberries, while not having any significant impact on the other two small fruits.

Looking at the alternative-specific penalties, the results show that for our sample, most statistically significant cut-offs violation have a negative sign (cost, Italian and Trentino origin, and IPM production) but different intensity. In details, violating cost implies the greatest disutility in the choice of both blueberries (β = -0.734) and raspberries (β = -0.762) and the penalty coefficient is almost four times greater than its impact on choice probability. Violating Italian origin lead to greatest penalization for strawberries (β = - 1.131) and the second one for raspberries (0. 517). This result is quite unexpected. Given the model results of no or negative influence of Italian origin on the probability of purchasing raspberries and strawberries respectively, we expected that its violation would also play no role. Finally, it is interesting to note that for our sample, violating organic production and good appearance were found to be not significant for all the small fruits, while the innovative production related penalty was found to be significantly positive for strawberries only. Moreover, penalties were found to have greater magnitude when the low level, rather than the high one, of each attribute was violated.

4.5.2.3 The enhanced Swait model

The third model represents our proposed model incorporating some context ef-

fects. Parameters of context effect were assumed common to both competing alternative with respect to the alternative under observation, to capture the general effect of context on the choice of a product[19]. The hypothesis is that, in evaluating violations of competing alternatives, consumers tend to consider these violations jointly as if they were a single element. This means, for blueberries, for example, the effect of cost violation of both raspberries and strawberries were estimated using a generic parameter for both violations (VcostRasp&Straw/Blue).

With respect to Model 2, including generic context effects in the model improves the model fitting (from LL= -2775.36 to LL= -2749.57, from AIC = 2.242 to AIC =2.241), but the first Bayesian Information Criterion decreases (from 2.358 to 2.412). The Likelihood ratio test reveals that we can strongly reject the null hypothesis that context effects play no role in the choices (that is to say all context effect parameters are simultaneously zero) compared to the Swait's model (χ2statistic=51.58, df=24, p-value: <0.001).

In general, incorporating context effect changes the significance and the magnitude of some attributes (the sign of the attribute coefficient instead remains most times unvaried). Only four attributes proved to be strongly significant (at 1% level): good appearance for raspberries and strawberries, organic production and Italian origin for strawberries. The effect of good appearance decreased, while that relating to Italian origin increased. The effect of organic production increased for strawberries, while it decreased for blueberries and raspberries. The significance of cost, blueberry and raspberry organic production, and blueberry good appearance and Trentino origin decreases notably, while their magnitude slightly decreases. Blueberry mediocre appearance become

[19] This means, for blueberries for example, we estimated the effect of cost violation of both raspberries and strawberries using a common parameter for both violations (VPriceRasp&Straw/Blue).

significant, while raspberry Trentino origin becomes insignificant.

Looking at cut-off violations specific to each product and comparing them to those of Model 2, the results show that including context increases the statistical significance of violation coefficients, in particular for blueberries. In details, in the choice of blueberries, besides the cost violation that still leads to the greatest penalization, violating organic production, good appearance and Trentino origin becomes significant. For raspberries, in addition to significant violations in Model 2 that remained so in Model 3, violating IPM become significant. Also for strawberries, significant violations in Model 2 remained so in Model 3, but violating Trentino origin that does not exert anymore any effect.

Looking now to the context effects, the Model 3 shows that only some violations of attribute thresholds occurring in competing alternatives influence significantly the choice of an alternative under observation (Table 4.9, section 3). In details, context plays a role mainly in the choice of raspberries, indicating that raspberries may represent the "third" choice among the three fruits. Its probability of being chosen increases when violations of mediocre appearance, Italian origin and cost occurring in the competing alternatives increase. The strawberry related utility increases when innovative production is violated in the competing alternatives, while it decreases when the violation refers to IPM production. Finally, blueberries are only affected positively, by the violation of innovative production in the other two products. The results relating to innovative production are, however, quite unexpected, given that this attribute does not prove to have any influence on the choice of all products.

Table 4.9. Estimates of the several models with and without cut-off information and context effect

Section 1	**(1)MNL without penalties**	**(2)MNL with specific penalties**		**(3)MNL with cumulative context effects**	
Attributes	Coeff. (t-stat)	Attributes	Coeff. (t-stat)	Attributes	Coeff. (t-stat)
PipmBlue	0.023(0.24)	PipmBlue	-0.057(-0.45)	PipmBlue	-0.020(-0.15)
PipmRasp	0.007(0.06)	PipmRasp	-0.196(-1.34)	PipmRasp	-0.113(-0.72)
PipmStraw	-0.069(-0.76)	PipmStraw	-0.314(-2.57)***	PipmStraw	-0.240(-1.88)*
PinnBlue	0.001 (0.00)	PinnBlue	0.033 (0.29)	PinnBlue	-0.017(-0.13)
PinnRasp	0.160(1.49)	PinnRasp	0.164(1.29)	PinnRasp	0.136(0.98)
PinnStraw	-0.09(-1.01)	PinnStraw	-0.032(-0.29)	PinnStraw	-0.106(-0.86)
PorgBlue	0.410(3.81)***	PorgBlue	0.288(2.38)**	PorgBlue	0.238(1.76)*
PorgRasp	0.316(3.00)***	PorgRasp	0.300(2.49)**	PorgRasp	0.254(1.88)*
PorgStraw	0.254(2.76)***	PorgStraw	0.312(2.97)***	PorgStraw	0.335(2.72)***
QmBlue	0.362(4.20)***	QmBlue	0.238(1.61)	QmBlue	0.318(1.99)**
QmRasp	-0.279(-2.66)***	QmRasp	0.055(0.27)	QmRasp	0.063(0.30)
QmStraw	0.218(2.78)***	QmStraw	0.086(0.61)	QmStraw	0.134(0.92)
QhBlue	0.600(7.16)***	QhBlue	0.396(2.88)***	QhBlue	0.275(1.71)*
QhRasp	0.521(5.99)***	QhRasp	0.840(4.46)***	QhRasp	0.717(3.47)***
QhStraw	0.814(10.6)***	QhStraw	0.645(5.13)***	QhStraw	0.560(3.80)***
OitBlue	0.218(2.48)**	OitBlue	0.079(0.38)	OitBlue	0.179(0.83)
OitRasp	0.130(1.35)	OitRasp	-0.174(-1.06)	OitRasp	-0.21(-1.21)
OitStraw	0.337(3.90)***	OitStraw	-0.360(-2.81)**	OitStraw	-0.433(-3.18)***
OtnBlue	0.611(7.13)***	OtnBlue	0.445(2.24)**	OtnBlue	0.346(1.66)*
OtnRasp	0.719(7.67)***	OtnRasp	0.397(2.54)**	OtnRasp	0.236(1.27)
OtnStraw	0.865(12.1)***	OtnStraw	0.151(1.31)	OtnStraw	0.152(1.16)
CC	0.082(2.45)**	CC	0.065(1.90)*	CC	0.065(1.70)*
Cost	-0.370(-6.47)***	Cost	-0.203(-3.05)***	Cost	-0.137(-1.86)*
A_Blueb	0.582(2.92)***	A_Blueb	-0.016(-0.06)	A_Blueb	-0.030(-0.10)
A_Raspb	0.548 (2.83)***	A_Raspb	0.104(0.41)	A_Raspb	0.260 (0.83)
A_Strawb	0.704 (5.82)***	A_Strawb	-0.248(-1.40)	A_Strawb	-0.324(-1.39)

Section 2	(1)MNL without penalties	(2)MNL with specific penalties		(4)MNL with context effects	
		Cut-off penalties	Coeff. (t-stat)	Cut-off penalties	Coeff. (t-stat)
		VPipmBlue/Blue	-0.144(-1.04)	VPipmBlue/Blue	-0.159(-1.10)
		VPinnBlue/Blue	0.114 (1.16)	VPinnBlue/Blue	0.149(1.42)
		VPorgBlue/Blue	-0.129 (-1.54)	VPorg Blue/Blue	-0.263(-2.41)**
		VQmBlue/Blue	-0.203(-1.10)	VQmBlue/Blue	-0.139 (-0.74)
		VQh Blue/Blue	-0.107(-1.30)	VQh Blue/Blue	-0.159(-1.67)*
		VOitBlue/Blue	-0.182(-0.63)	VOitBlue/Blue	-0.109(-0.37)
		VOtnBlue/Blue	-0.98(-1.30)	VOtnBlue/Blue	-0.157(-1.82)*
		VCostBlue/Blue	-0.734(-5.05)***	VCostBlue/Blue	-0.688(-4.18)***
		VPipmRasp/Rasp	-0.250(-1.64)	VPipmRasp/Rasp	-0.328(-2.06)**
		VPinnRasp/Rasp	0.109(1.04)	VPinnRasp/Rasp	0.189(1.70)*
		VPorgRasp/Rasp	-0.036(-0.42)	VPorgRasp/Rasp	-0.072(-0.66)
		VQmRasp/Rasp	0.553(2.17)**	VQmRasp/Rasp	0.634(2.43)**
		VQhRasp/Rasp	-0.038(-0.43)	VQhRasp/Rasp	-0.044(-0.43)
		VOitRasp/Rasp	-0.517(-2.51)**	VOitRasp/Rasp	-0.527(-2.47)**
		VOtnRasp/Rasp	-0.98(-1.152)	VOtnRasp/Rasp	-0.109(-1.14)
		VCostRasp/Rasp	-0.762(-5.60)***	VCostRasp/Rasp	-0.817(-5.48)***
		VPipmStraw/Straw	-0.227(-1.69)*	VPipmStraw/Straw	-0.244(-1.73)*
		VPinnStraw/Straw	0.208(2.23)**	VPinnStraw/Straw	0.234(2.32)**
		VPorgStraw/Straw	-0.033(-0.43)	VPorgStraw/Straw	-0.057(-0.61)
		VQmStraw/Straw	-0.190(-1.18)	VQmStraw/Straw	-0.124(-0.75)
		VQhStraw/Straw	-0.036(-0.48)	VQhStraw/Straw	-0.073(-0.86)
		VOitStraw/Straw	-1.131(-7.40)***	VOitStraw/Straw	-1.032(-6.44)***
		VOtnStraw/Straw	-0.121(-1.77)*	VOtnStraw/Straw	-0.098(-1.27)
		VCostStraw/Straw	-0.085(-0.66)	VCostStraw/Straw	-0.070(-0.51)

Section 3	(1)MNL without penalties	(2)MNL with specific penalties	(4)MNL with context effects	
			Cut-off penalties	Coeff. (t-stat)
			VPipmRasp&Straw/Blue	-0.051(-0.59)
			VPinnRasp&Straw/Blue	0.139(2.03)**
			VPorgRasp&Straw/Blue	0.070(1.13)
			VQmRasp&Straw/Blue	0.123(1.35)
			VQhRasp&Straw/Blue	0.055(1.13)
			VOitRasp&Straw/Blue	0.037(0.40)
			VOtnRasp&Straw/Blue	0.066(1.51)
			VCostRasp&Straw/Blue	0.041(0.44)
			VPipm Blue&Straw/Rasp	0.084(0.96)
			VPinnBlue&Straw/Rasp	0.072(1.03)
			VPorgBlue&Straw/Rasp	0.018(0.29)
			VQmBlue&Straw/Rasp	0.2152.57)**
			VQhBlue&Straw/Rasp	0.017(0.34)
			VOitBlue&Straw/Rasp	0.183(1.82)*
			VOtnBlue&Straw/Rasp	0.025(0.54)
			VCostBlue&Straw/Rasp	0.162(1.81)*
			VPipmBlue&Rasp/Straw	-0.154(-1.84)*
			VPinnBlue&Rasp/Straw	0.179(2.68)***
			VPorgBlue&Rasp/Straw	-0.006(-0.11)
			VQmBlue&Rasp/Straw	0.039(0.54)
			VQhBlue&Rasp/Straw	0.068(1.48)
			VOitBlue&Rasp/Straw	0.116(1.57)
			VOtnBlue&Rasp/Straw	-0.003(-0.07)
			VCostBlue&Rasp/Straw	0.105(1.61)
LL funct	-2848.66	-2775.36	-2749.57	
R-sq Adj Const. only	0.167	0.1862	0.1911	
I Crit.AIC	2.281	2.242	2.241	
I Crit BIC	2.342	2.358	2.412	
# parameter	26	50	74	

choice set : 2520; *** significant at 1% level, **significant at 5% level,* significant at 10% level

[a]The 'R-squareds' shown in the output are R^2s in name only. They do not measure the fit of the model to the data. It has become common for researchers to report these with results as a measure of the improvement that the model gives over one that contains only a constant. But, readers are cautioned not to interpret these measures as suggesting how well the model predicts the outcome variable. It is essentially unrelated to this (Greene, 2007:N11-23).

4.5.3 Willingness to pay estimates

Focusing on the above results, we examined the effect on marginal willingness to pay amounts including the specific threshold (Model 2) and generic context effects (Model 4) into modelling the consumer's choice. WTP values were calculated in different ways according to the occurrence of violations. For each type of small fruit, when no cut-offs were violated, WTP values were calculated as the ratio of that attribute's coefficient to the negative of the price coefficient, that is to say for example looking at blueberries the WTP for Italian origin is equal to $\frac{-(\beta Oit_{Blue})}{\beta Cost}$ (Hensher et al., 2005a). However, since in our study the variables are effect coded, the estimated coefficients have to be multiplied by 2 to get the actual WTPs (Bech and Gyrd-Hansen, 2005). Therefore, in this case the WTP for Italian origin becomes equal to $\frac{-2\times(\beta Oit_{Blue})}{\beta Cost}$.

When a cut-off for any attribute except price is violated, the marginal WTP is equal to $\frac{-2\times[\beta Oit_{Blue}+\beta VOit_{BLue}]}{\beta Cost}$, while if the opposite happens, i.e. only the price cut-off is violated, the WTP is $\frac{-2\times(\beta Oit_{Blue})}{(\beta Cost+\beta VCost_{Blue})}$ (Bush et al.,2009; Aizaki et al., 2010). When both price and other attribute cut-offs are violated, then the WTP is $\frac{-2\times[\beta Oit_{Blue}+\beta VOit_{BLue}]}{(\beta Cost+\beta VCost_{Blue})}$ (Bush et al.,2009). In the model incorporating context effect, the WTP is calculated also adding the effect of violation of the examined attributes in competing products, i.e. in Model 4:

$$\text{WTP}Oit_{Blue} = \frac{-2\times\lfloor\beta Oit_{Blue}+\beta VOit_{BLue}+\beta VOit_{Rasp\&Straw/\,Blue}\rfloor}{(\beta Cost+\beta VCost_{Blue}+\beta VCost_{Rasp\&Straw/\,Blue})}.$$

The average WTP values for each small fruit are reported in Table 4.10 and they refer to the usual packaged boxes of small fruits found in supermarkets: a 125g box for blueberries and raspberries and a 250g box for strawberries.

Table 4.10 Willingness-to-pay values for small fruits by different models (Euro box)

	Model 1			**Model 2**			**Model 4**		
	MNL without penalties			**MNL with penalties**			**MNL with context effect**		
Attribute	Blueber.	Raspberr.	Strawber.	Blueber.	Raspberr.	Strawber.	Blueber.	Raspberr.	Strawber.
Pint	0.12	0.04	-0.37	-0.12	-0.41	-5.33***	-0.05	-1.1	-9.30*
Pinn	0.01	0.86	-0.49	0.07	0.34	1.74	0.30	0.82	4.48
Pbio	2.22***	1.71***	1.37***	0.61**	0.62**	3.07***	-0.06*	0.64*	4.89***
Qm	1.96***	-1.51***	1.18***	0.51	1.26	0.85	0.77**	2.30	1.96
Qh	3.24***	2.82***	4.40***	0.85***	1.74***	6.35***	0.28*	1.81***	8.18***
Oit	1.18**	0.70	1.82***	0.17	-1.43	-14.69**	0.43	-1.40	-21.39***
Otn	3.30***	3.89***	4.68***	0.95**	0.82**	0.29	0.46*	0.60	2.22
CC	0.44**	0.44**	0.44**	0.14*	0.13*	0.64*	0.16*	0.16*	0.95*

Comparing the WTP estimates of the three models shows that the effect of threshold and context effect are significant. In the model without penalties, for all three small fruits a major premium price has been found for Trentino origin (3.95 Euro/box on average) and good appearance (3.49 Euro/box on average) followed by organic production (1.77 Euro/box on average). Respondents are also willing to pay a small premium price of about 0.44 Euro/box for CC, while in general not significant premium price has been found for the alternative production methods that employ IPM and BCAs. WTP for mediocre appearance and Italian origin depends heavily on the product. Consumers are willing to pay around 2.00 euro/box for mediocre appearance for blueberries and 1.18 euro/box for strawberries, while for raspberries they show a negative WTP. This last negative WTP may indicate that consumer would like to have only raspberries of high

visual quality, perceiving that they are one the most fragile and perishable of all fruits and the shelf life of which can be greatly reduced by storage temperatures above 0 °C (Salunkhe and Desai, 1984). Therefore, negative WTP may mean that consumers require a sort of compensation which may be in the form of a price discount in order to buy mediocre raspberries (Onyango and Govindasamy, 2005). Moreover, they are willing to pay a premium for Italian origin for blueberries (1.18 Euro/box) and strawberries (1.82 Euro/box) but not for raspberries.

Incorporating penalties in general reduces WTP values for blueberries and raspberries by a factor of 3.5 and increases those for strawberries by at least 1.5. The highest WTPs were found for strawberry and raspberry good appearance and strawberry organic production, while the lowest WTP was for climate change mitigation practices. It is interesting to note that really high negative WTPs have been found for strawberry Italian origin and IPM production. This may suggest the importance these attributes have for those individuals who prefer them, reflecting the fact that the absence of these feature s leads to a great disutility attached to strawberries. Or in the case of Italian Origin may reflect the lack of information associated to “abroad” origin. In the survey, in fact “abroad has not been specified, leading consumers to convey their own information. The negative WTP may indicate that some consumers may perceive strawberries coming from abroad better than Italian, maybe associating to the word “abroad” higher qualitative standards. Furthermore, adding context effect further reduces WTP values for blueberries by a factor of 2 and increases those for strawberries (by a factor of at least 1.3), while WTP values are maintained for raspberries. It also exacerbates the difference of premium prices for climate change mitigation practices for the three small fruits: 0.16 euro/box for blueberries and raspberries, and almost 1 euro/box for strawberries. Other differences regard premium prices for blueberries. For this product, the highest premium price is for

mediocre appearance (0.77 Euro/box), while the one relating to organic production becomes negative, although it is close to zero (-0.06 Euro/box).

4.5.4 Latent class modelling

Since models 2 and 3 confirm the role of cut-offs as heuristics used in the decision making process, we applied a latent class model (finite mixing panel) to investigate the probability of membership of three latent classes: those who made use of a compensatory rule (Class 1), those who employed a non compensatory rule (Class 2) and those who employed a non compensatory rule and looked at the context (Class 3). In our latent class approach, the population is assumed to be divided into different classes constrained to have some attributes set as to a value equal to zero, while the non-zero coefficients are estimated for each class in order to estimate taste heterogeneity. A particular case is represented by constraining the non-zero coefficients to be equal across classes (Hensher, 2009; Scarpa et al., 2009a) that allows to discover only the belonging to a class rather than another.

To account for the condition of using a compensatory rule (Class 1), we set both the parameters relating to penalties and context effect to zero for Class 1; while to account for people who used a non compensatory rule without though looking at the context (Class 2), we set only the context effects to zero. Finally, to account for people who employed a non compensatory rule and looked at the context (Class3), we do not set any parameter to be zero, estimating therefore all parameters.

The model correctly predicts 1626 choices out of the total of 2520 observed choices (64.52%). In general, results showed that the consumers were more likely to use a non compensatory rule (65,3%) rather than a compensatory rule (34.7%) when purchasing small fruits. Among those who made use of a non-compensatory rule (183 peo-

ple), a 20.3% where influenced by context effect (Class 3). The formal test of equality given by the Wald statistic showed that class specific estimates for all attributes but the innovative production are different from each other (P-vlaue <0.001). Overall, Class 2 is most likely and Cass 3 least likely to choose the "None of these" option.

Comparing the relative importance of the attributes across latent classes shows remarkable differences among the three classes. For Class 1 that makes use of a compensatory rule Trentino origin is the most important attribute followed by appearance, organic production, Italian origin and price, attributes that have similar importance. Climate change practices, IPM and innovative production gain instead very little importance. For Class 2 that makes use of cut-offs without context, price represent the most important factor, followed by good appearance, and organic production. The less important factor is the climate change practices. For Class 3, appearance resulted to be the most important followed by IPM and organic production. Climate change practice s have medium importance, while origin and cost are of little importance.

Table 4.11. The relative attribute importance[a] for the three classes

Attributes	Class 1	Class 2	Class 3
Pint	1.02%	4.97%	19.94%
Pinn	1.62%	1.19%	5.41%
Pbio	12.35%	14.51%	15.61%
Qm	13.90%	5.68%	26.22%
Qh	12.41%	25.38%	14.46%
Zit	10.89%	7.41%	1.79%
Ztn	34.29%	6.79%	4.68%
CC	2.78%	0.89%	8.09%
C	10.72%	33.19%	3.79%

[a] Relative importance is obtained rescaling maximum effects that add up to 1 within a latent class

To understand the use of a non-compensatory rule, we investigated the role of socioeconomic factors in influencing the decision making process by running an explora-

tory binary logit model (Table 4.12). However, although the model correctly classified 68% of the observations, the low pseudo R-squared value (2%) indicates that socio economic characteristics poorly predicts the use a rule rather than another. Only two predictors were found to be significant, after the elimination of statistically insignificant variables. Female shoppers and, having a college degree (with respect to not having) increase the probability of using a non compensatory rule. Education, marital status, Income, HH composition, HH food expenditure, practising agricultural activities, considering oneself an environmentalist and belonging to an environmental association proved, on the contrary, not to have any influence.

Table 4.12. Determinants of use of a compensatory rule (logit regression, n = 280)

Determinants	Coefficient (Standard error)
Female	0.728 (0.338)**
College (Education)	0.607 (0.317)*
Constant	-0.092(0.323)
Observations	280
Prob. > χ^2	<0.05
Pseudo R^2	0.02
Correctly classified (%)	67.9

***, ** and * significant at 1, 5, 10%

4.5.5 Simulation and scenario testing

As seen in the previous section, context effect does play a role in the decision making process. To further investigate the implications of this result, we conducted a number of simulations to test different scenarios of price increases. Scenarios in the simulations involve changing attribute levels and recomputing probabilities and sample shares so as to examine the effect of the change on aggregate (Greene, 2007). With this

tool we tested the likely impact of a price increase from 2% to 50% for all four models. One simulation regards the simultaneous increase of price of both blueberries and raspberries. In fact, in supermarkets, the price of these two small fruits is usually found to be the same and so it is valid to assume simultaneous changes of price. The other simulation involves an increase of the price of strawberries (from 2% to 50%). The base market shares for the four alternatives presented in the choice card calculated on the 2520 actual choices of respondents are the following: Blueberries = 21%, Raspberries =19% , Strawberries = 33% and None of these products = 27%.

Results indicate that not taking into account context effect may lead to an overestimated change of market share (mean factor of 1.93), leading therefore to consider respondents as more sensitive to price changes (Figures 4.4 and 4.5). In details, results show that consumers are more price sensitive for blueberries and raspberries than for strawberries. This may indicate that consumers are more used to price variations in strawberries, as these are present all year round. In fact, the price on Trentino market varies from 2 euro/Kg in February when strawberries are imported from Spain to 8-10 euro/Kg in autumn when they are produced locally[20]. However, results show that in general when the price increases – whether it refers to strawberries or to blueberries and raspberries - respondents prefer slightly more not to buy small fruits than to buy another small fruit.

[20] Market prices collected from preliminary research in different supermarkets during the year.

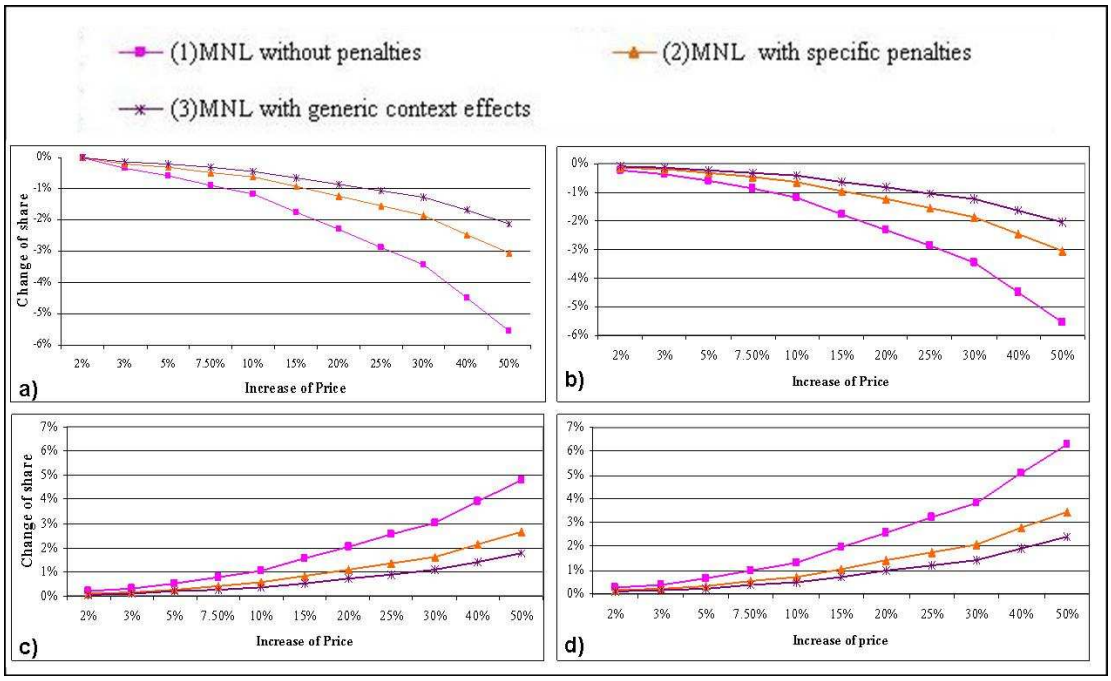


Figure 4.4. Effect of a simultaneous price increase (from 2% to 50%) of blueberries and raspberries on blueberries (a), raspberries (b), strawberries (c) and none-of-these option (d).

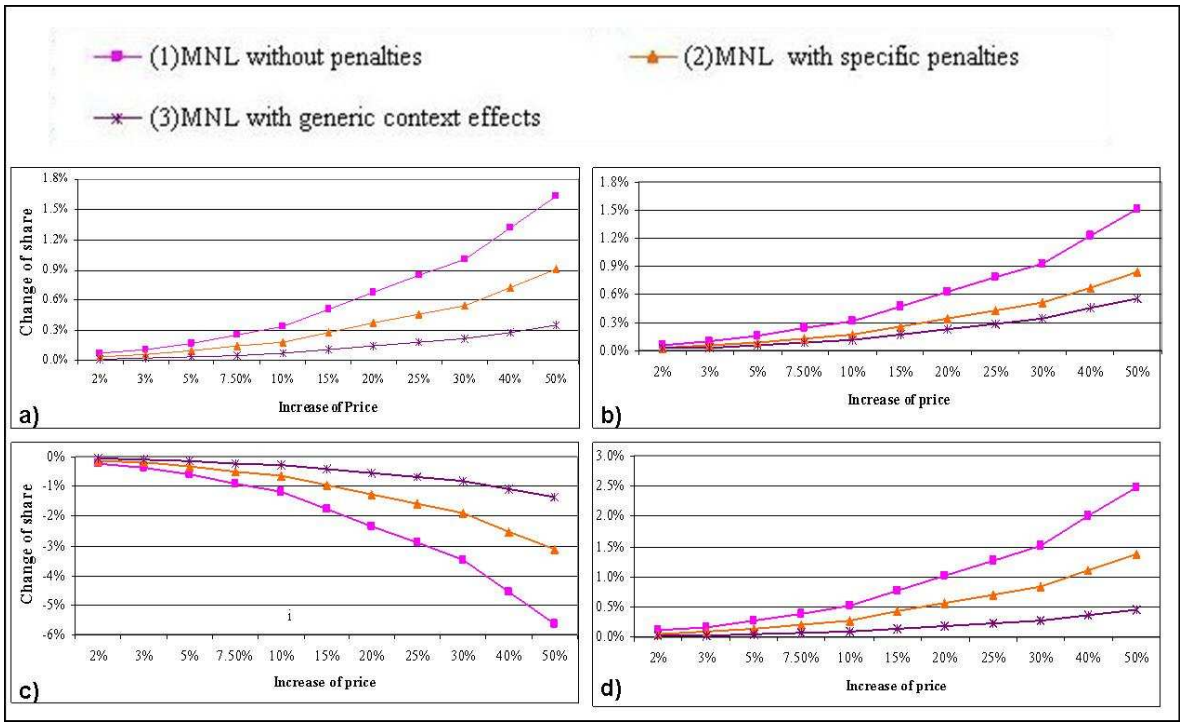


Figure 4.5. Effect of a strawberry price increase (from 2% to 50%) on blueberries (a), raspberries (b), strawberries (c) and none-of-these option (d).

4.6 Conclusions

In this study, we contribute to the literature by proposing a cut-off approach that incorporates cut-off violations as context effects. In our model, the consumer's utility associated with an alternative depends not only on the violation of threshold values in that alternative, but also on violations that occur in competing alternatives. Moreover, this study differs from previous ones since it focuses the attention on attributes not directly related to the taste or flavour of a product. We in fact tested the proposed model by estimating consumers' preferences for small fruits obtained with alternative production systems that employ different mixtures of chemicals, natural substances and beneficial microorganisms, and with farming practices that aim to mitigate climate change.

4.6.1 Discussion of results

Starting from a qualitative analysis of the data collected in the survey, we found that most consumers stated they had cut-off values in mind when purchasing small fruits, in particular for origin and appearance, stating Trentino origin and good appearance as minimum requirements. Just under one third of respondents stated they did not have any cut-off values on the method of production in mind. However, comparing the choices made by respondents with their individually-stated cut-offs, results show that only 3% of respondents behaved consistently and never violated their stated cut-offs in all nine choice cards, by confirming Swait's idea of minimum requirements as soft rather than hard cut-offs. Most consumers violate the minimum requirements they have in mind and they prefer therefore to suffer a utility penalty, rather than giving up that alternative. Un-expectedly, the greatest number of violations occurred for good appearance and Trentino origin, while the lowest was found for organic production, suggesting that people who state that requirement tend to be more consistent in their choices and may consider it a

real binding requirement, in other words a hard cut-off, for purchasing small fruits. Regarding the order of importance, respondents ranked origin and appearance as most important followed by method of production, price, and lastly climate change mitigation practices. However, comparing ranking and choice modelling results has shown that this order is not confirmed, indicating that respondents might be not consistent with their expressed values.

From the modelling analysis, results show that context effect – intended as violations occurring in competing alternatives - plays a role in the decision making process. Incorporating context effects improved model fitting although not to the extent of the improvement relating to the incorporation of cut-offs. Incorporating context effect into a utility function resulted in influences on the estimated values of coefficient attributes, affecting them in terms of both significance and magnitude.

Only the good appearance and organic production attributes for strawberries were found significant to all models and to all three small fruits, increasing the probability of purchasing small fruits, and more specifically, the influence of the former was always greater than the latter, confirming previous findings that appearance is often the main driver for buying and being willing to pay for fruit (Zanoli et al. 2003; Ernst et al. 2006)[21]. The significance of other attributes relies instead strongly on the model used.

Mediocre appearance and Trentino origin was found to be significantly positive only for blueberries, while origin was found to have a negative (Italian) or no (Trentino) influence on the probability of purchasing strawberries. This is quite unexpected as the results are in contrast with previous literature. Several studies have indeed found that local production is usually one of the top ranked attributes that influence the purchase and consumers' willingness to pay for berries (Mellor et al. 2001; Scarpa & Spalatro, 2001;

[21] For a review see previous chapter.

Ernst et al., 2006; Darby, 2006). In particular for strawberries, Darby et al. (2006) found that for locally grown strawberries, US consumers are willing to pay around $ 1.00 on average more than the berries identified simply as "produced in the U.S.”.

The results of our model show that in general the alternative production methods proposed (IPM and BCAS) impact not in a statistically significant way. This outcome suggests that consumers, besides preferring organic production among other methods, seem not to have in mind a clear frame of the other different production methods, even if a clear definition was provided in the survey. This is an unexpected result given that in Trentino most fruit production has been obtained using IPM systems for quite some time. In fact, the first IPM programs in agriculture were introduced in the mid-1980s (Moser et al., 2008). These results may also indicate the lack of effective guarantees evident to consumers that convey information regarding the improvement of these practices with respect to conventional ones. In fact, it may reflects the fact that IPM related benefits are not clear for consumers, since the replacement of synthetic pesticides is somehow "indefinite" and dependent on circumstances. This makes the standard itself unclear, indefinite and subject to a wide variability of constraints, leading consumer to think that it could be a risk of abuses.

Currently, IPM grown fruit is, indeed, not typically labelled as such, conversely to what happens for organic fruit. Explicit “IPM Grown” product labelling would be a method to differentiate these products from conventionally and organically grown fruits and vegetables and add value to them (Govinsdamy and Italia, 1998). However, IPM labelling is not a guarantee of success as pointed out by Ferraro and Rowles (2001). In actual fact, Blend and Van Ravenswaay (1999) found that consumers who had prior familiarity with IPM concepts were less likely to buy IPM labelled apples than those that did not have this prior knowledge.

As regards organic production, it proved to have a higher impact for strawberries compared to the other two berries. This may reflect the mind association that respondents make regarding blueberries and raspberries of small fruits as being safe and growing naturally in the bush, and which are therefore "intrinsically" grown organically without the need to be certified.

The climate change related attribute was also found to increase slightly the probability of purchasing (at 10% level). This may indicate that currently consumers are not fully informed about these practices or they do not perceive their importance in reality. However, this result is encouraging for future research. Increasing education on the issue of climate change and information on how agriculture can reduce greenhouse gas emissions may increase awareness of consumers who may therefore demand food with less impact on CC and be willing to pay a premium price for these practices (Consumers International and BEUC, 2009; Dodds, 2010). Another explanation of both the low value of the CC coefficient and its significance level may be related to the fact that it is the only public attribute investigated among mainly private attributes. Incentives to provide accurate answers can indeed differ for private or public goods (Carson and Groves, 2007).

Cost decreases notably its significance in our model. However, previous studies (Owen, Griffith, and Wright, 2002) reported that "price is not a highly relevant variable in the in-store choice of fruit and vegetables" and that what matters more is the overall amount of money spent on this product category (Jaeger and Rose, 2008).

Incorporating context effects also influences the values of penalties, increasing their magnitude and significance, in particular those referring to blueberries. Results show that violations of a stated cut-off imply a disutility depending on the small fruit. Violations of cost are the most relevant for blueberries and raspberries, while the viola-

tion relating to Italian origin is strongly relevant for strawberries. With regards to cut-off variables, it is interesting to note that correspondence between the impact of an attribute and its violation is only reached for blueberries. For raspberries and strawberries we found that the violation of attributes that most influence the probability of purchasing them - good appearance and organic production - do not have any significant effect, contrasting with previous results. Green et al., (1988) found that respondents were more likely to be consistent with the stated cut-off if the attribute is an important one. The opposite happens instead for Italian origin and alternative production methods. These exert a negative or zero impact on utility, although their violations do. Violating Italian origin however leads to the greatest penalization for strawberries and represent the second most important violation for raspberries. This result might appear in contrast with the negative coefficient of Italian origin of strawberries. However, since our model does not reflect respondent heterogeneity, the cut-off may indicate that among those individuals who prefer Italian origin there is a great disutility attached to the absence of this attribute. This, then, is reflected into negative WTPs. In addition, it is interesting to note that most of the statistically significant cut-offs have a coefficient greater than the estimated beta for the related attributes, evidencing marked non-linearities in demand (Bush et al., 2009; Marcucci and Gatta, 2010).

With regard to context effects, intended as the effect of violations occurring in competing alternatives, this study shows that they are present and that in general they influence positively the choice of an alternative. The choice of raspberries proved to be the most affected, in particular by the failure to reach the mediocre appearance in blueberries and strawberries. Interestingly, strawberries proved to be negatively affected by the violation of IPM production of blueberries and raspberries.

Moreover, this study shows that the difference in consumer preferences among the models increases when preferences were translated into WTP measures. This is a result of the substantial difference in price sensitivity (Darby et al., 2006).

Finally, the results show that ignoring context effect in choice behaviour may induce marketers to adopt misleading marketing strategies. Simulations of different price increases do in fact indicate that not taking into account context effects may result in an inflated change of share forecast, and to conclusions that consumers are more price sensitive than they actually are.

4.6.2 Limitations and future research

In this section we describe some limitations and possible extensions of our study.

Firstly, although several measures were adopted to avoid biases, caution is still needed in interpreting the results and WTP measures since they may depend heavily on the hypothetical form of the survey method used in this study. As a next step it would be interesting to perform a real CE, where respondents would be informed that one of the choice cards of the CE would be randomly selected at the end of the experiment and that they had to buy and pay for with their own money the product indicated in that card, if they had selected one. This type of mechanism, where a randomly selected choice scenario becomes effective, has been widely used in CE (Lusk et and Schroeder, 2004; Ding et al., 2005; Alfnes et al., 2006; Lusk et al., 2008; Johansson-Stenman and Svedsäter, 2008). Once controlled there will be no statistically significant difference between samples, it would then be possible to discover the presence of the hypothetical bias and, if positive, to measure its width. However, in the absence of locally developed calibration functions, one may correct for hypothetical bias following previous results in literature (Scarpa et al., 2009b). Murphy (2005a) conducted a meta-analysis and found that the

median ratio of hypothetical to real valuations to be equal to 1.35, while Chowdhury et al. (2009) found a factor greater than 2. Therefore, to correct for a hypothetical bias, one can scale down the estimated values by a number that ranges between one-half and one-third.

Secondly, thresholds used in the model are self reported and were assumed to be fixed and exogenous to the choice. However, there is concern that attribute cut-offs are not exogenous to choices, but are jointly determined with choices (Swait, 2001; Ding et al., 2010). Several studies have addressed the issue of endogeneity associated with attribute cut-offs (Klein and Bither, 1987; Huber and Klein, 1991; Swait, 2001) and found that cut-offs are influenced by a number of factors, such as an individual's knowledge of the attributes (Huber and Klein,1991) and by the circumstances (choice context) (Swait, 2001). To solve the issue of endogeneity the most common approach has been to create instrumental variables in model estimation (Ding et al., 2010). Ding et al., (2010) used predicted cut-offs based on respondents' demographic characteristics as instruments for self-reported cut-offs and found that respondents' demographic characteristics explain some of the cut-off levels selected for some attributes. Another solution has been proposed by Elrod et al. (2004). They developed an integrated model that relies on observed choices rather than on self-reported cut-offs. As regards the assumption of fixed cut-offs, evidence shows that cut-offs may also change over time due to experience, learning, or due to more information availability about the attributes and the decision task (Klein and Bither, 1987; Huber and Klein, 1991). Future research should be devoted to considering how the cut-off model can be extended to incorporate dynamic cut-offs. Moreover, self reported cut-offs were assumed to have no measurement error. Nevertheless, as Swait (2001: p.925) pointed out, if it is assumed that an error occurs in stating thresholds, then

an error term should be added, which would require the development of specialized software, constituting another area for future research.

Thirdly, in this paper, due to the large number of parameters to be estimated, we employed an MNL model under the homogenous preferences assumption to estimate consumer preferences. However, this assumption may be wrong and may lead to an overestimation of cut-off and context effects on decision making (Swait, 2001). Swait (2001) and Hutchinson et al. (2000) suggested indeed that the unobserved heterogeneity may be an alternative explanation for any effect ascribed to cut-offs or context. Therefore, the next step would be to test the proposed model by controlling for unobservable preference heterogeneity among the respondent using a random parameter logit to understand whether cut-offs and context actually capture unique effects.

Moreover, we recognize the MNL may be not the appropriate model in a labelled experiment such as the one presented in this paper. In fact, by their nature labelled experiments are likely to result in IID violations (Jaeger and Rose, 2008). Respondents may use the names of the alternatives to convey some missing information, and since the inferences are usually correlated with the error term, this leads to violation of the IID assumption (Hensher et al., 2005; Jaeger and Rose, 2008).

Fourthly, in our model only the utility of the alternatives with a context dependent component has been directly modelled as a function of context, while the one related to the none-of-these option has not. However, previous studies show that context effects also impact directly on the no-choice option (Dhar, 1997b; Dhar and Simonson, 2003; Rooderkerk et al., (2009). For example, when the choice task becomes too difficult, the choice of the none-of-these option increases (Dhar, 1997b). Therefore, although our

model indirectly accounts for the context effects on the none-of-these alternative,[22] it would be interesting to explore the direct effect.

Finally, other areas of potential interest have been identified, besides those described above, that could represent the next steps in this research.

Future steps may extend the current model by incorporating other information collected during the survey such as ranking. In actual fact, although we asked respondents to rank the attributes in order of importance, ranking did not enter into the modelling decision. Several studies have proposed enhanced models to incorporate both discrete choice analysis and qualitative information (Gilbride et al., 2005; Morey et al., 2006; Hu, 2008). However, in most economic studies, the qualitative information is either not used or is used separately from the quantitative analysis (Hu, 2008). Future research should focus on developing a model design that includes ranking information into the utility function in order to obtain more precise estimates.

Another step may consider exploiting the internal source of data as the response time for the choice task, incorporating it within the consumer choice model, to predict different strategies used by respondents. Previous studies have shown that there is a relationship between response time and preference by means of choice uncertainty and difficulty (Haaijer et al., 2000; Duquette et al., 2009; Netzer et al., 2008). Several studies have considered response times as objective proxy for cognitive resource constraints and found that shorter response times represent more certain choices (Haaijer, et al., 2000) or that longer response times may represent more difficult choices. Moreover, Bröder and Gaissmaier (2007) observed that response times increase slightly for users of compensatory strategies.

[22] Context effects affect the utilities of the choice options, which may increase or decrease their attractiveness compared to the no-choice option (Rooderkerk et al., 2009).

APPENDIX 4.A.

Customer Intercept Survey

This appendix contains the customer intercept survey (originally in Italian). Survey has been adapted from a Pc survey, so the presentation and style of questions may be not the same as in the reality. Dot line indicates the separation of different screens.

1. Are you the primary food shopper in your household? (make 50% or more of all purchases)
   - ◎ Yes
   - ◎ No

2. When you do food shopping, do you buy sometimes small fruits (strawberries, raspberries, blueberries)?
   - ◎ Yes
   - ◎ No

---

3. For who, do you buy small fruits (strawberries, raspberries, blueberries)?
   - ◎ Myself
   - ◎ My family
   - ◎ Both

4. How many times do you consume these products?

Berries	Never	During holidays or on special occasions	Only on season	Once a month	2/3 times a month	Once a week	2-3 times a week
Blueberries	◎	◎	◎	◎	◎	◎	◎
Raspberries	◎	◎	◎	◎	◎	◎	◎
Strawberries 250g	◎	◎	◎	◎	◎	◎	◎
Strawberries 500g	◎	◎	◎	◎	◎	◎	◎

5. If only on season, how many times?

Berries	Once a month	2/3 times a month	Once a week	2-3 times a week
Blueberries	◎	◎	◎	◎
Raspberries	◎	◎	◎	◎
Strawberries 250g	◎	◎	◎	◎
Strawberries 500g	◎	◎	◎	◎

---

6. When is the last time you bought small fruits?

Berries	Today	Yesterday	This week	Last week
Blueberries	◎	◎	◎	◎
Raspberries	◎	◎	◎	◎
Strawberries 250g	◎	◎	◎	◎
Strawberries 500g	◎	◎	◎	◎

7. Do you remember how much did you spent?

Berries	No	Yes (scroll bar)
Blueberries	◎	◎
Raspberries	◎	◎
Strawberries 250g	◎	◎
Strawberries 500g	◎	◎

---

8. When you decide to buy small fruits, where do you buy them? (multiple choices)
   - ◎ at superstore
   - ◎ at supermarket
   - ◎ at discount store
   - ◎ at market
   - ◎ at grocery store
   - ◎ at the shop of farmers' association
   - ◎ directly from the farmer
   - ◎ other _____

In the following questions, the term local fruits (or produced locally) refers to fruit produced in your Province.

9. If available, do you choose locally-grown produce when you shop at supermarkets?

Never	Rarely	Sometimes	Often	Always
◎	◎	◎	◎	◎

---

10. Here are some factors why you might buy fruits produced in your Province. Please indicate the degree of importance for each the following factors.

Factor	Not important	Somewhat Unimportant	Neutral	Somewhat Important	Extremely Important
Freshness	◎	◎	◎	◎	◎
Taste	◎	◎	◎	◎	◎
Safety	◎	◎	◎	◎	◎
Support local farms	◎	◎	◎	◎	◎
I know the area of fruit production	◎	◎	◎	◎	◎
I know how the fruit is produced	◎	◎	◎	◎	◎
Reduce food-miles	◎	◎	◎	◎	◎

---

11. Do you read the labels on the fruit package or ask for information regarding the origin of the fruit?

Never	Rarely	Sometimes	Often	Always
◎	◎	◎	◎	◎

12. When buying fruit and vegetables, do you look for a brand that certifies the type of production used?

Never	Rarely	Sometimes	Often	Always
◎	◎	◎	◎	◎

Please read carefully the following information.

In the box, small fruit can be:

1.**Of good appearance**: Blueberries, strawberries and raspberries are intact, turgid, well-sized and even and bright colored Moreover, there are not bruised, mouldy or shrivelled fruits.

2.**Of mediocre appearance:** Some fruits are small sized, uneven colored (with green or pale colored parts), and have a damaged skin.

3**. Of bad appearance:** Some fruits are small sized, uneven colored (with green or pale colored parts), and have a damaged skin. There also some bruised, mouldy or shrivelled fruits.

Nowadays, there are four methods of production that allow growers to control pest and disease of small fruits:

Conventional control	**Integrated pest management (IPM)**	**Innovative management**	**Organic production**
A pest management strategy that employs pesticides (chemicals) to reduce pest and disease.	A pest control strategy that integrates chemicals with biological agents (insects, microorganisms and natural enemies), agronomic techniques and cultural methods and implies a reduction of chemicals with respect to conventional control.	A IPM that intensify the use of biocontrol agents and agronomic techniques as much as possible till reaching a further reduction of the number of chemical treatments with respect to IPM control.	A pest control that excludes or strictly limits the use of synthetic fertilizers and synthetic pesticides, and that maintains, promotes and enhances biodiversity, biological cycles, and soil productivity.

Each of these growing methods can be carried out with low greenhouse gases (carbon dioxide and methane) emission and therefore with a low impact on climate change (i.e. the increase in temperature and the related consequences) .

Now, you are in this store to shop. Please read carefully the following example.

" When I go to the supermarket, I think:

"Apples I buy have to be at least Italian, be of mediocre appearance and cost less than 2 euro/kg, otherwise I do not buy them."

Now, THINK when you decide to buy a box of small fruits. Are there some characteristics that they need to have ?

---

13. I buy small fruits only if obtained with the growing method:

Blueberries	It does not matter	Integrated (IPM)	Innovative	Organic
Raspberries	It does not matter	Integrated (IPM)	Innovative	Organic
Strawberries	It does not matter	Integrated (IPM)	Innovative	Organic

14. I buy small fruits only if produced

Blueberries	Everywhere, even abroad	In Italy	In Trentino
Raspberries	Everywhere, even abroad	In Italy	In Trentino
Strawberries	Everywhere, even abroad	In Italy	In Trentino

15. I buy small fruits only if their appearance is

Blueberries	It isn't important	Mediocre	Good
Raspberries	It isn't important	Mediocre	Good
Strawberries	It isn't important	Mediocre	Good

---

16. The price for box has not to be over Euro …
Please indicate for each fruit, the maximum price you are willing to pay for a box: remember that blueberries and raspberries are sold in a 125 g box, while strawberries in a 250g box

	Euro	Euro	Euro	Euro	Euro	Euro	
Blueberries	2.45	2.75	3.10	3.45	3.8	4.15	Price does not matter
Raspberries	2.45	2.75	3.10	3.45	3.8	4.15	Price does not matter
Strawberries	0.95	1.35	1.75	2.15	2.55	2.95	Price does not matter

---

17. In choosing which small fruit to buy, rank now in order of importance the following aspects from 1 to 5 with 1 being the most important and 5 the least important (the first touched on the screen is the most important, the second is the second most important and etc.).

Appearance | Price | Origin | Production method | Reduced greenhouses gas

---

The Choice

Now it starts the most useful part of the research. You will be asked to make 9 independent choices among three products that vary for origin, method of production, appearance, attention devoted to climate change and price.
Previous studies have demonstrated that people often respond to surveys differently from how they behave in a real purchase situation. It is particular common that one states a higher willingness to pay than what one actually is willing to pay for the good in the store, leading to unusable results. This happens because it is easy to be generous when one does not have to pay more in the store or because one generally has the tendency to choose an answer which is viewed as more socially acceptable than the other ones, or one that is perceived as being a desirable answers to the interviewer.
Therefore, we ask you to carefully consider the cost of the presented products and to choose your preferred product thinking only about your own personal preferences.

Now, imagine yourself to be in the following situation:

Today is a normal day (you are not on holidays and there is no special occasion), you feel good and you have buying small fruits in mind.

Which product would you choose to purchase among those presented, if today these products were the only ones available?

	Blueberries 125g	Raspberries 125g	Strawberries 250 g
Method of Production	Integrated	Organic	Conventional
Appearance	Mediocre	Good	Bad
Origin	Abroad	Trentino	Italy
Reduced Climate Impact	No	No	Yes
Price	2.75	3.45	1.75
Your CHOICE is	⬆	⬆	⬆
	None of these products		

Example of choice card employed in the survey (9 choice cards were presented to each respondent)

---

18. Thinking at the choices you have just made, please indicate the order of importance of the following aspects from 1 to 5 with 1 being the most important and 5 the least important.

Appearance	Price	Origin	Production method	Reduced greenhouses gas

---

The following questions are about you and your family

In this section, we will ask you some questions about you and your family that will help us to compare your responses with that of other interviewed persons. Please note that all responses are strictly confidential and all information collected will be anonymous.

---

1. Gender
   - ◎ Female
   - ◎ Male

2. Approximately how much does your household spend each week to buy food produce? Please give us your best estimate.

   _____

3. Please describe the community in which you currently live (Check one)
   - ◎ City centres
   - ◎ Suburban/surrounding areas
   - ◎ Villages\small villages
   - ◎ Isolated areas

---

4. What is your age?: _____

5. Excluding yourself, how many of the people in your household are in the following age groups? (Enter the appropriate number of people in each category)

◎ Under 14 years	1	2	3	4	5	6
◎ 15 to 19 years	1	2	3	4	5	6
◎ 20 to 30 years	1	2	3	4	5	6
◎ 30 to 64 years	1	2	3	4	5	6
◎ 64 years and more	1	2	3	4	5	6

---

6. What is your nationality?
   - ◎ Italian
   - ◎ CEE countries (excluding Italy)
   - ◎ Extra CEE countries

7. What is your marital status? (Check one):
   - ◎ Single
   - ◎ Married or similar
   - ◎ Separated/Divorced
   - ◎ Widowed

8. What level of education did you complete? (Check one)
   - ◎ Elementary school
   - ◎ Middle school
   - ◎ 3 years diploma
   - ◎ High school diploma
   - ◎ College/university degree
   - ◎ Post university education

---

9. What is your job/profession?
   - ◎ Entrepreneur/Self-employed
   - ◎ Executive
   - ◎ Office worker
   - ◎ Worker
   - ◎ Housewife
   - ◎ Actually unemployed
   - ◎ Fixed-term/Project contract
   - ◎ Student
   - ◎ Pensioner

10. Approximately how much is your monthly household net income (Euro/ month)
    - ◎ <1000
    - ◎ 1000-2000
    - ◎ 2000-3000
    - ◎ 3000-4000
    - ◎ >4000
    - ◎ I don’t know

---

11. Do you consider yourself as an environmentalist?
    - ◎ Yes
    - ◎ No

12. Do you belong to an environmental association?
    - ◎ Yes
    - ◎ No

13. Do you or does your family practice agricultural activities?
    - ◎ Yes
    - ◎ No

THANK YOU FOR YOUR PARTECIPATION!

APPENDIX 4.B.

The Experimental design

In this Appendix we provide the table with the experimental design employed in the survey.

Choic	alt1.a	alt1.b	alt1.c	alt1.d	alt1.e	alt2.a	alt2.b	alt2.c	alt2.d	alt2.e	alt3.a	alt3.b	alt3.c	alt3.d	alt3.f	Block
11	convenzion	mediocr	trentino	si	2.4	convenzic	bello	italia	si	2.75	biologica	brutto	estero	no	2.95	1
12	innovativa	bello	estero	si	3.8	biologica	bello	trentino	si	3.8	convenzior	brutto	italia	no	0.95	1
19	biologica	brutto	estero	si	4.15	convenzic	bello	trentino	no	3.8	innovativa	mediocr	estero	no	0.95	1
20	innovativa	mediocr	trentino	no	3.45	integrata	mediocr	italia	si	2.75	biologica	bello	italia	si	2.55	1
26	biologica	brutto	estero	no	3.8	integrata	bello	trentino	si	2.4	innovativa	mediocr	trentino	si	2.55	1
28	integrata	bello	italia	no	3.45	biologica	mediocr	estero	no	3.45	innovativa	brutto	italia	si	2.15	1
29	convenzion	mediocr	italia	si	3.1	innovativa	brutto	estero	no	4.15	biologica	bello	trentino	si	0.95	1
30	innovativa	brutto	trentino	si	4.15	biologica	mediocr	estero	no	3.45	integrata	brutto	italia	no	0.95	1
33	convenzion	brutto	italia	si	2.4	integrata	bello	trentino	no	3.1	innovativa	mediocr	estero	no	2.15	1
1	convenzion	bello	estero	no	3.8	innovativa	mediocr	italia	no	3.1	biologica	brutto	trentino	si	1.75	2
8	innovativa	brutto	estero	si	4.15	integrata	mediocr	trentino	no	2.4	biologica	bello	italia	no	2.15	2
9	biologica	brutto	trentino	no	2.4	convenzic	bello	estero	si	3.45	integrata	mediocr	italia	no	2.55	2
14	innovativa	mediocr	italia	no	3.1	biologica	bello	estero	no	3.1	integrata	brutto	trentino	si	2.15	2
17	innovativa	bello	italia	no	2.4	integrata	brutto	trentino	si	2.75	convenzior	mediocr	estero	no	2.95	2
18	convenzion	bello	trentino	no	4.15	innovativa	mediocr	estero	si	2.4	integrata	brutto	italia	si	2.55	2
22	biologica	bello	italia	no	2.75	biologica	mediocr	italia	si	3.45	integrata	mediocr	trentino	si	2.55	2
34	biologica	bello	trentino	si	2.4	innovativa	brutto	italia	si	3.45	convenzior	mediocr	estero	no	2.15	2
35	integrata	bello	estero	si	3.8	convenzic	brutto	italia	si	3.8	biologica	mediocr	trentino	no	0.95	2
2	integrata	bello	italia	no	3.1	convenzic	brutto	trentino	no	4.15	innovativa	bello	estero	si	1.35	3
3	biologica	mediocr	trentino	no	2.75	convenzic	brutto	italia	no	2.4	innovativa	bello	estero	si	2.95	3
10	integrata	mediocr	estero	no	2.4	innovativa	brutto	italia	no	2.4	convenzior	bello	trentino	si	2.95	3
13	integrata	mediocr	italia	si	2.75	biologica	brutto	estero	si	3.8	convenzior	bello	trentino	no	2.15	3
24	integrata	mediocr	estero	no	2.75	biologica	bello	trentino	no	3.45	convenzior	brutto	italia	si	1.75	3
27	innovativa	bello	italia	no	2.75	integrata	brutto	trentino	no	4.15	convenzior	mediocr	estero	si	1.35	3
31	integrata	brutto	estero	si	4.15	innovativa	bello	italia	no	2.75	convenzior	mediocr	trentino	no	1.35	3
32	convenzion	mediocr	italia	si	3.1	innovativa	brutto	trentino	no	4.15	biologica	bello	estero	si	1.35	3
36	biologica	mediocr	estero	si	3.1	integrata	brutto	estero	no	4.15	innovativa	bello	trentino	si	1.35	3
4	biologica	brutto	estero	si	3.8	integrata	brutto	italia	si	3.1	innovativa	bello	trentino	no	1.75	4
5	biologica	brutto	italia	no	3.1	innovativa	bello	trentino	no	3.8	convenzior	mediocr	estero	si	1.75	4
6	innovativa	mediocr	estero	si	3.45	convenzic	bello	estero	no	4.15	integrata	brutto	trentino	si	1.35	4
7	convenzion	bello	italia	no	3.45	integrata	mediocr	estero	si	2.75	biologica	mediocr	italia	no	2.95	4
15	innovativa	brutto	trentino	no	3.45	convenzic	bello	estero	si	2.4	integrata	brutto	italia	no	2.95	4
16	convenzion	brutto	trentino	si	3.8	biologica	mediocr	italia	si	3.1	integrata	bello	estero	no	1.75	4
21	integrata	mediocr	trentino	no	2.75	innovativa	mediocr	italia	si	3.1	biologica	brutto	italia	si	2.55	4
23	integrata	bello	trentino	si	3.45	convenzic	mediocr	estero	si	3.8	innovativa	brutto	italia	no	0.95	4
25	convenzion	brutto	trentino	si	4.15	biologica	mediocr	trentino	si	2.75	integrata	bello	estero	no	1.75	4

APPENDIX 4.C.

Description of utility function employed in the models estimated in this study

Model (1): the no cut-off model

$$U(i) = ASC_i + \sum \beta_{ki} X_{ki} + \sum \beta_k X_{ki}$$

Model (2): the Swait's model with alternative specific penalties

$$U(i) = ASC_i + \sum \beta_{ki} X_{ki} + \sum \beta_k X_{ki} + \sum \beta_{ki} V_{ki}$$

Model (3): Enhanced Swait model with alternative specific penalties and generic context effect

$$U(i) = ASC_i + \sum \beta_{ki} X_{ki} + \sum \beta_k X_{ki} + \sum \beta_{ki} V_{ki} + \sum \beta_k V_{kj} \quad \forall j \neq i$$

where:

$\sum \beta_{ki} X_{ki} = \beta_{Ipmi}*Pipm_i + \beta_{Inni}*Pinn_i + \beta_{Orgi}*Porg_i + \beta_{Qmi}*Qm_i + \beta_{Qhi}*Qh_i + \beta_{Oiti}*Oit_i + \beta_{Otni}*Otn_i,$

$\sum \beta_k X_{ki} = \beta_{cc}*CCi + \beta c*Ci$ (generic attributes),

$\sum \beta_{ki} V_{ki} = \beta_{VPinti}*VPint_i + \beta_{VPinni}*VPinn_i + \beta_{VPbioi}*VPbio_i + \beta_{VQmi}*VQm_i + \beta_{VQhi}*VQh_i + \beta_{VOiti}*VOit_i + \beta_{VOtni}*VOtn_i + \beta_{VCi}*VC_i$

$\sum \beta_k V_{kj} = \beta_{VPint*}VPint_j + \beta_{VPinn}*VPinn_j + \beta_{VPbio}*VPbio_j + \beta_{VQm}*VQm_j + \beta_{VQh}*VQh_j + \beta_{VOit}*VOit_j + \beta_{VOtn}*VOtn_j + \beta_{VC}*VC_j \quad \forall j \neq i$

Chapter 5

Summary and Concluding remark

5.1 Summary and future research

The present work presents an analysis of the potential development and use of biocontrol agents in small fruit production in Trentino. The analysis has been made for both supply and demand sides. I investigated the farmers' attitude to an IPM that employs BCAs extensively to understand which are the factors that may prevent the adoption on large scale for this strategy and which may represent the key for its success. From the consumer side, I investigated the consumers' preferences and their willingness to pay for fruit obtained with this practice.

Chapter 2 contributes to the literature, presenting a first comparative study of farmers' perceptions and habits using a biocontrol approach in an IPM program for strawberry pest control in diverse agricultural systems. Results show that in Israel and in Trentino, confidence of growers in BCAs is affected by personal hands-on experience and suggestions made by cooperatives or growers' associations. Moreover, media as a source of information regarding BCAs was found to influence it positively, while years of strawberry farming experience negatively. Interestingly, it has also been found that knowledge of the positive effects of BCAs have a significant effect, while negative features play no role. Lack of confidence by farmers in BCAs was instead generated by in-

experience, fears of losses and having a bias, and by the limited promotion of these methods by local research centers and biocontrol companies.

The comparison among different agricultural systems shows that the socio-economic context plays a determinant role in the adoption of BCAs in an IPM program. The presence of growers' associations and expert advisors able to follow growers in the first stages of BCAs application, a well-planned pest control program, a government that indirectly assist farmers, an active and supportive network that promotes results of experiments and that advertises BCA-treated products in the market place are factors that may increase growers' knowledge of BCAs and thereby facilitate the inclusion of BCAs in IPM programs. Besides aiming to overcome BCAs strictly related limitations, further research should be devoted to understand the role of government and of different knowledge networks in disseminating information about BCAs. Further research also may investigate the effect of government assistance to growers to understand which policy lead to better results in adoption of sustainable techniques. Last, but not least, in seeking to widespread sustainable practices, further research should aim to understand how farmers of staples or widely grown crops as grape or apples react to sustainable strategies.

Chapter 3 identifies and ranks the attributes which drive consumers buying behavior of sustainable fruit and vegetables. Seven attributes are found to be strongly determinant – but even their relevance is differentially valued depending on the area studied. In short, health related characteristics and eating quality as appearance continue to prevail in the choice to buy and in the WTP for fresh fruit with credence attributes. A surprising result relates to Europe, where credence attributes (environment and farmers' support, origin, local, and organic) have found to have either somewhat limited or little importance. This is quite unexpected given the effort of European Union's Common Ag-

ricultural Policy (CAP) to introduce sustainable practices among growers and to increase peoples' sensitivity to environmental and social issues linked to agricultural practices in rural areas. Among other attributes, particular attention deserves the attribute "Local". It resulted to be popular and increasing in relevance when compared to organic, certification, and origin in developed countries, even though it is less formally defined than 3rd party certification programs, such as organic. Further research should be devoted to investigate the effect of claims used for credence attributes so far, and to find solutions to increase the value of food certifications. Further research is needed to estimate consumer response to other sustainable practices, such as low carbon footprint products, and to investigate the distinction between tangible and intangible attributes, Finally, this study provides a list of the research areas: the effect of providing information on sustainable practices on willingness to pay, the interaction effect among different attributes and the role of processing information within consumers' choice.

Chapter 4 presents a choice experiment to study consumers preference for three small fruits (strawberries, blueberries and raspberries) obtained with BCAs and with climate change mitigation practices. This chapter contributes to the literature by proposing a cut-off approach that incorporates cut-off violations as context effects. That is, the consumer's utility associated to an alternative depends not only on the violation of stated threshold values in that alternative, but also on violations that occur in competing alternatives. The modelling analysis shows that violations occurring in competing alternatives play a role in the decision making process and influence the estimated values of coefficient attributes and penalties which are affected in terms of both significance and magnitude.

Several unexpected results were found. First, among different production methods, only organic production influences positively the probability of purchase small fruits, while alternative production methods (IPM and BCAs) do not have any significant impact on it. Rather, IPM was found to negatively impact on strawberries. Second, Trentino origin (therefore local) resulted to play a positive role on the probability of purchase only for blueberries, while it resulted not significant for raspberries and strawberries. Moreover, Italian origin was found to have a strong negatively influence for strawberries, in contrast with result obtained from previous chapter. Third, price is no longer listed as the top criterion to purchase small fruits. Cut-off related results show moreover that the disutility associated to violations depend on the type of small fruit: violations of cost are the most relevant for blueberries and raspberries, while the violation relating to Italian origin is strongly relevant for strawberries. Moreover, coefficient related to significant cut-offs are bigger than the beta of the attribute they are associated with. Regarding context effects, the violations occurring on competing alternatives affect positively the choice of an alternative, in particular of raspberries. That means that respondents also choose a product pushed by failure to reach a certain threshold in other products. In fact, results of a latent class model showed that 20% of the sample looked at the context effect in making decisions.

Moreover, results show that ignoring context effect in choice behaviour may induce marketers to adopt misleading marketing strategies. Simulations of different price increases indicate, indeed, that not taking into account context effects may results in an inflated change of share forecast, and to conclusions that consumers are more price sensitive than they actually are. In addition, results show that most of interviewed people stated to have minimum requirements in mind when purchasing small fruits and that among those who stated a minimum requirement, 97% violated them. This outcome con-

firms both previous literature that individuals use heuristics to simplify their decision making and Swait's (2001) approach treats self reported cut-offs as "soft" cut-offs.

Finally this study proposes further lines of research based on exploiting internal and external source of data as the response time for choice task and qualitative data collected for example through ranking.

5.2 Concluding remark

To conclude, some consideration can be driven from the present work.

In all three studies resulted that in pursuing a more sustainable farming system, it becomes essential to provide more information both to farmers and consumers. Information plays a determinant role indeed on change the attitude people have towards a product obtained with new farming techniques. Results of a recent Eutobarometer survey [23] (2008, 2010) reveal that half EU citizens would like to receive more information on food safety and one third on the environmental effects of farming and that this information gap has not been plugged over the years, given that people keep demanding more information on these aspects of agriculture. Future studies would be devoted to test which information regarding alternative methods as BCAs or practices that lower GHG emissions is more effective in influencing the consumers perception of these methods and which is instead ignored by consumers.

In diminishing the gap of information inside of the agricultural food chain, retailers could play a key role in promotion sustainable products by increasing the visibility of these products on store shelves or by having a green corner dedicated to such products (Eurobaromer, 2009). In spreading the use of BCAs, the supply chain may play a key

[23]The Eurobarometer survey series is a unique programme of cross-national and cross-temporal comparative social research sponsored by European Commission to monitor social and political attitudes.

role since retailers have now the power to decide which products sell, the price, and also decide to delist suppliers who do not meet their requirements (Brouwer and Bijman, 2001). Given the increasing consumers' concerns about food safety and quality, environmental sustainability and appropriate methods of production, retailers may seek to accommodate these concerns by changing farming practices in order to offer safer and more sustainable products (Brouwer and Bijman, 2001; Levidow and Bijman, 2002). They might set up higher quality control systems asking some requirements to which supplying farmers have to comply (Brouwer and Bijman, 2001). The extensive use of BCAs may represent a requirement. Moreover, providing such alternative products may be part of a competition strategy, since retailers may gain a competitive advantage by advertising their company as being an environmentally conscious food supplier and increasing customer loyalty (Bech-Larsen, 2000). However, in order to implement a successful differentiation strategy for product derived with IPM+BCAs and to convince consumers that these practices confer a value added, the first step retailers have to make is to differentiate IPM product in the food market selling them at a different price with respect to the conventional. Actually, indeed, as reported by Levidow and Bijman (2002) IPM food is generally sold at the same price as conventional.

In support of this, Israeli experience showed that advertising the BCA-treated product in the marketplace is a valid tool to increase consumers' awareness of the positive characteristics of these products. Labelling could represent a valid tool to provide information and increase transparency about production of these product increasing consumers' confidence of being able to personally deal with possible problems of chemical contamination (e.g. pesticide residues) (EB, 2010). Since farmers were found to be an important actor with respect to information on food risks improving the contact between the producer and the consumer may be an important driver of general consumer confi-

dence in the safety of food (Grunert, 2002; Brunel, O., & Pichon, P.-E., 2004; de Jonge et al., 2008).

To sum up the research in agriculture, above all that one relative to BCAs, needs of a greater interdisciplinary exchange and collaboration among different scientific disciplines. This is necessary to overcome the "bottle necks" that still prevent or limit the adoption of sustainable practices and to increase the consumer’s awareness.

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